Diagnostic Study on Agrarian Changes in Nonghet District, Xieng Khouang Province: *Exploring Pathways Towards Improved Livelihood and Food Security*

Agriculture Research Report

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ChildFund works in partnership with children and their communities to create lasting and meaningful change by supporting long-term community development and promoting children's rights.

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Summary

This report investigates recent land use changes in Nonghet District, Xieng Khouang Province and their impacts on agriculture and livelihoods. The agricultural transition from shifting cultivation, subsistence-based agriculture to maize mono-cropping-based, commercial agriculture has profoundly transformed local livelihoods. In general, villagers consider themselves richer than before but the combined effects of intensification, expansion and specialisation of agriculture have had adverse effects on the environment. While the negative effects are not yet perceived by all villagers, it is obvious for everyone that the intensive agricultural practices based on mechanical tillage and the use of herbicides are not sustainable, and alternatives need to be found.

Intervention topics and mechanisms should therefore be adapted to the specific context of all villages, which can be easily mapped using two indicators: agroecology and accessibility. Villages at different stages of the maize boom: (i) subsistence farming, (ii) surfing the maize wave and (iii) maize aftermath, will require different solutions to their specific problems. Integrated approaches to local development are suggested as alternatives to the often disconnected interventions that address symptoms more than the roots of the problems. The empowerment of both village communities and district technical agencies in co-designing intervention pathways that are adapted to local conditions would greatly contribute to the emergence of sustainable agriculture and restoration of degraded agro-ecosystems. Last, but not least, the creation of an enabling institutional environment by capitalising on knowledge from field experience and supporting policy formulation (e.g. herbicide ban) would insure the lasting impact of project activities beyond the initial partner villages and also beyond the project period.

Acknowledgements

The authors would like to acknowledge the support received by the whole ChildFund team, both in Vientiane and Nonghet, especially Mrs Marieke Charlet-Phommachanh, Mr Yermoua Yougchue, Mr Khamphanh Panya and Mrs Keoamphone Souvannaphoum. Mr Yermoua contributed to all aspects of the fieldwork. He helped with all practical arrangements and was directly involved in household surveys, focus group discussions, and preparation of the final workshop together with two staff from the Department of Agriculture and Forestry Office of Nonghet District, Mr Kouya and Mr Chuya. Thank you all for your support and lively discussions during this short mission.

We also sincerely thank all village heads and villagers in the visited communities for the time they spent with us answering questions, sharing their experiences, and designing future development scenarios during the validation workshop.

I. Introduction

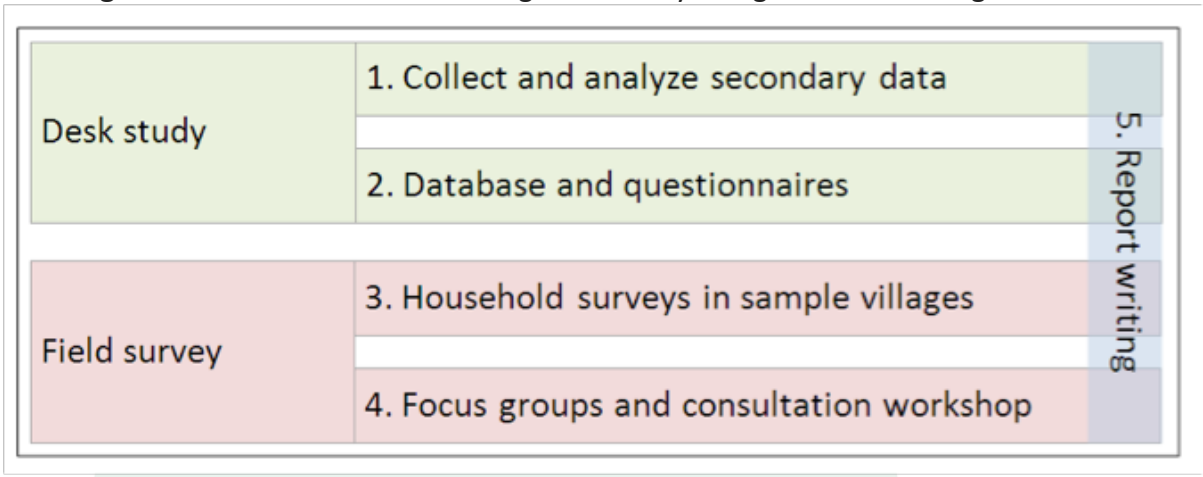
Nonghet District is one of the forty-seven poorest districts in Laos and one of three poorest districts in Xieng Khouang Province. Farming households face specific constraints to sustainable intensification of agricultural production, including tough topography, presence of unexploded ordnance, limited access to secure land tenure, and land degradation due to unsustainable farming practices. Over the recent years, the production of maize to be sold in Vietnam has gradually replaced the rice fields that were traditionally used for family consumption. Rapid agricultural changes are associated with an increased use of pesticides (especially herbicides), expansion of commercial crops leading to rampant deforestation, and a gradual specialisation, i.e. fewer crops grown per household, which reduces agrobiodiversity and resistance to climate change and causes price fluctuations.

Concerned with these major threats to local development, ChildFund Laos has worked in the district since 2010 to help overcome food insecurity and increase the income of poor households so as to improve the nutritional status of children and, more generally, their well-being. ChildFund activities conducted in the two partner village groups (a total of 12 villages) mainly consist of training in sustainable intensification and diversification of crop and livestock production and linking village communities to the market to diversify income generation opportunities. The design with and adoption by village communities of new agricultural practices helps to improve food sufficiency and generate additional income. Proposing concrete and realistic options, including market options, to improve livelihoods, with both a short-term and long-term perspective, requires a good understanding of agricultural changes on multiple scales, i.e. from household to village and district levels. A diagnostic study was conducted over the whole month of March, 2014, for this purpose.

II. Methods

The study consisted of five activities: (i) a literature review (collection and analysis of secondary data), (ii) preparation of questionnaires and databases for data collection, (iii) household surveys in eight selected villages, (iv) focus group discussions and a consultation workshop to validate the results of the study and to explore development scenarios, and (v) data analysis and report writing (Figure 1).

Figure 1. Main activities of the diagnostic study on agriculture in Nonghet District



The methods used were adapted to the limited time available for the overall study (one month) and to constraints specific to field activities (i.e. mobilisation of villagers to attend meetings and focus group discussions) as well as to the human resources available (Table 1). The two consultants in charge of the study were supported by a ChildFund staff member during the whole fieldwork period (10 to 21 March), and by two staff from DAFO, who helped with data collection and preparation of the consultation workshop on March 21. The questionnaires were kept as short as possible (less than 30 minutes per household), and the number of villages and households were kept to a minimum: from 30 households in large villages and up to 80% of total households in small villages (Table 2).

Table 1. List of activities and methods used for the diagnostic study

Activities	Methods
1: Collecting and analysing secondary data Study existing project documents and diagnostic studies conducted in Nonghet District on farming systems and land-use changes	Compilation of secondary data available for Nonghet District with particular emphasis on ChildFund's partner villages
2: Planning field activities Define relevant indicators and questions based on secondary data Dimension research design, based on time, human resources, and available finances	Household survey questionnaires (Appendix 1), Village sampling (8 villages) based on multiple criteria: accessibility, ChildFund activities and availability of previous data, Focus group discussions
3: Understanding agricultural situation Socio-economic data generated to document the agricultural situation in the district and to support negotiations among stakeholders during the consultation workshop	Socio-economic survey of randomly selected households in 8 villages using questionnaires, Data entry in the database and verification, Data analysis and comparison with secondary data
4: Exploration of solutions Focus group discussions to assess potential solutions with villagers and explore possible development pathways in 4 villages, Consultation workshop to share and validate the main results of the study.	Results from desk and field studies validated by local stakeholders during the consultation workshop, Proposed solutions explored collectively, leading to concrete recommendations to ChildFund.

Village selection

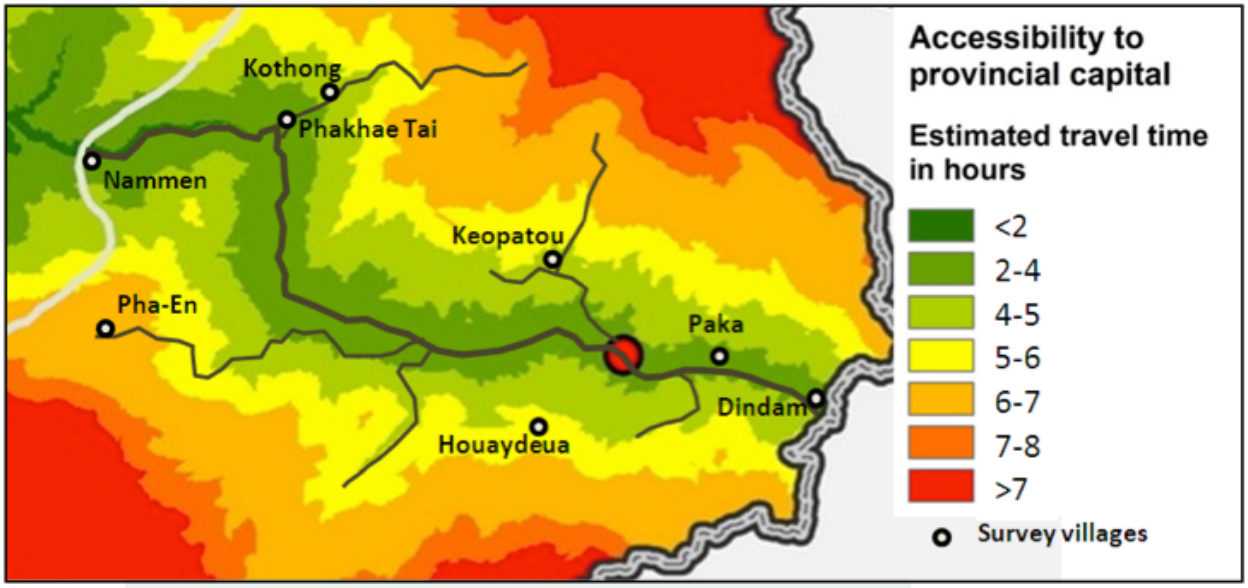
The village selection procedure took into account the results of the literature review. The 3 villages of Phakhae Tai, Nammen, and Keopatou werse selected in order to capture historical changes. They had been surveyed in 2003 and 2009 as part of the baseline and impact study of a project dedicated to conservation agriculture. A new survey in 2014 made it possible to understand changes over the past decade. Six villages of the 12 current partner villages of the ChildFund project (Nammen, Phakhae Tai, Korthong, Houaydeua, Paka, and Dindam) were selected plus one village, Pha-En, which is scheduled to start project activities in the coming months (Table 2).

Table 2. Main characteristics of the surveyed villages

Village	Distance to main road	Ethnic groups (No HH)			Village size	Sample size	ChildFund activities	Surveyed in 2003-2009
	Km	H'mong	Khmu	Lao loum	No HH	No HH	Year	Yes/No
Keopatou	7	73	0	0	73	30	-	Yes
Nammen	0	1	73	20	94	30	2010	Yes
Phakhae Tai	0	33	12	113	158	30	2010	Yes
Korthong	3	42	0	0	42	25	2010	No
Pha-En	15	109	0	0	109	30	2014	No
Dindam	0	7	26	24	57	25	2010	No
Houaydeua	10	0	30	0	30	24	2010	No
Paka	0	63	0	0	63	18	2010	No

The villages were also selected according to their relative accessibility, which was expected to influence their level of integration with market and income generating opportunities for farming households (Figure 2).

Figure 2. Accessibility map of villages in Nonghet district to Phonesavanh

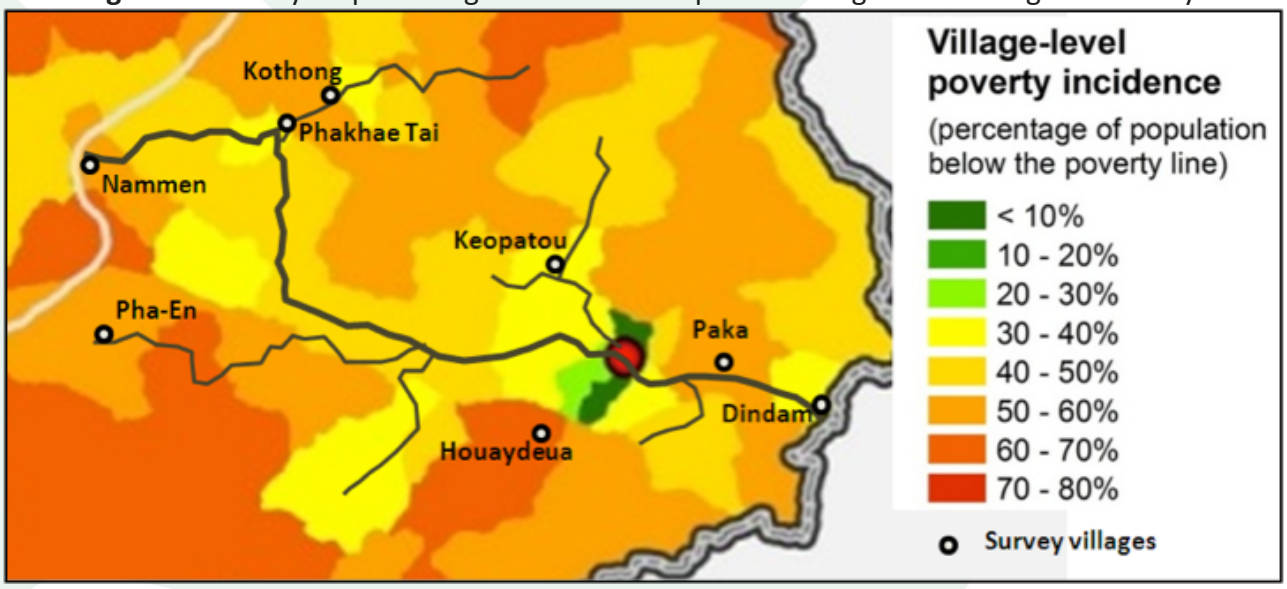


Source: Socio-economic atlas of Laos based on 2005 census.

Special attention was paid to biophysical conditions, with villages selected in the warm area of the district, i.e. the low-altitude basin close to Kham District in the western part, as opposed to the cooler area characterised by higher elevations and a more temperate climate with frosts during the winter, in the eastern part of the district.

Villages were also selected to cover the whole range of poverty incidence as characterised by the 2005 household expenditure census (Figure 3).

Figure 3. Poverty map of Nonghet District with partner villages of the diagnostic study.



Source: Socio-economic atlas of Laos based on 2005 census.

Data analysis and reporting

As mentioned above, data was combined from three main sources: the 212 households surveyed in 8 villages, 4 focus group discussions in Pha-En, Keopatou, Phakhae Tai, and Dindam villages and secondary data from the ChildFund project, DAFO, and former projects.

Household data was entered into Excel spreadsheets and verified for consistency and errors. Then, simple analyses were implemented using XLSTAT to generate histograms and graphs capturing the diversity of household strategies.

Data from focus group discussions pertained to the main characteristics of farming systems found in the four partner villages. Average values obtained during the discussions were compiled in an Excel spreadsheet. Cropping calendars, labour requirements, and economics of the different cropping systems were compared between villages located at different stages of an overall intensification gradient, and between households within the same village.

Unfortunately, village data was not available at DAFO for years before 2013. Results about land use changes therefore rely on data collected by other projects and not within the framework of this short-term consultancy.

Household data collection by DAFO staff; Focus group discussion in Keopatou Village

III. Land Use Changes in Nonghet District

Spatial patterns of land use changes over the past decades

The traditional agricultural system

In Nonghet District, traditional agricultural systems are based on a combination of paddy rice in the lowlands and upland rice in the hillsides. Vegetables are grown mainly for family consumption in home gardens, and in the swidden field mixed with upland rice. Traditional maize and cassava are grown in limited upland areas as a traditional staple food for people of the H'mong ethnic group and also as animal feed for pigs and poultry. Pigs are also fed with banana trunks found in the young fallows. Extensive livestock systems leave the cattle and buffaloes unattended most of the year. The paddies are protected against damages by the livestock with bamboo fences during the cropping season. As the swidden fields are generally grouped in blocks, the livestock are kept away during the cropping season by leaving them in the opposite area and visiting them from time to time (once a week on average) to bring them back away from the fields if necessary. The animals roam freely across the village landscape after the cropping season is finished. The remaining crops (e.g. cassava) must be protected with fences against livestock damage.

A single crop cycle is grown every year in the lowland, mainly due to lack of irrigation in the western part of the district, or to adverse climatic conditions in the eastern part of the district. There is an extended cool winter season with limited sunny days, and the fog is a constraint to traditional photoperiodic rice cultivars. New cultivars adapted to the "temperate" climate of these high-altitude areas have been tested by the National Rice Research Program as part of an intensification project, but this came at a time when farmers were more interested in intensifying agricultural production on the hillsides. The areas under paddies are very limited (Table 3) and intensification usually benefits the richest villagers (often the first settlers in the village) who have terraced the limited areas that could be irrigated and turned into paddies.

In the uplands that make up most of the landscape, rice is traditionally produced through shifting cultivation. A 5 to 10 year fallow is slashed and burned in March and the rice seeds are sown in April, at the beginning of the rainy season. One or two manual weedings are necessary to insure a good rice yield of about 2t/ha. Then, soil fertility is recovered by letting the field remain idle during a new fallow period. Non-timber forest products are often collected from the fallow for family consumption and also sold to generate cash income. Shifting cultivation optimises the return on labour, as labour force is a scarce resource in upland agriculture, while plenty of land is available. As a consequence, traditional land tenure systems on the hillsides are based on a combination of land reservation (ຈັບຈອງ = pre-emption) by families who have first opened land for cultivation and exchanges with other families depending on available labour force and the quality of the field (distance, soil fertility, age of the fallow, etc.). But with the increasing pressure on land due to population increase, the recent maize boom (see next section), and a government policy to eradicate shifting cultivation (e.g. land allocation of 3 plots per family), the fallow length has gradually decreased from 5 to 10 years to 2 or 3 years (Table 3), which makes shifting cultivation no longer sustainable. Rapid crop rotations with short fallow do not allow for sufficient soil fertility recovery before the next cropping cycle and exacerbate weed problems.

On the other hand, paddy rice cultivation optimises the return on land as a regular yield (as it is less dependent on climatic events than upland rice), and can be obtained with more labour investment on very limited areas. Land tenure over paddy fields is more secure with official land titles and detailed mapping available in most villages.

Table 3. Main crops in the surveyed villages - 2013

Village	Paddy area (ha)	Paddy area per HH (m2)	Fallow length (year)	Upland rice area (ha)	Maize area (ha)
Keopatou	30	4110	2	33	101
Nammen	18	1915	0	60	317
Phakhae Tai	13	823	0	11	557
Korthong	7	1667	0	19	121
Pha-En	4	367	3	216	220
Dindam	0	0	5	38	25
Houaydeua	1	333	2	33	62
Paka	0	0	3	75	185

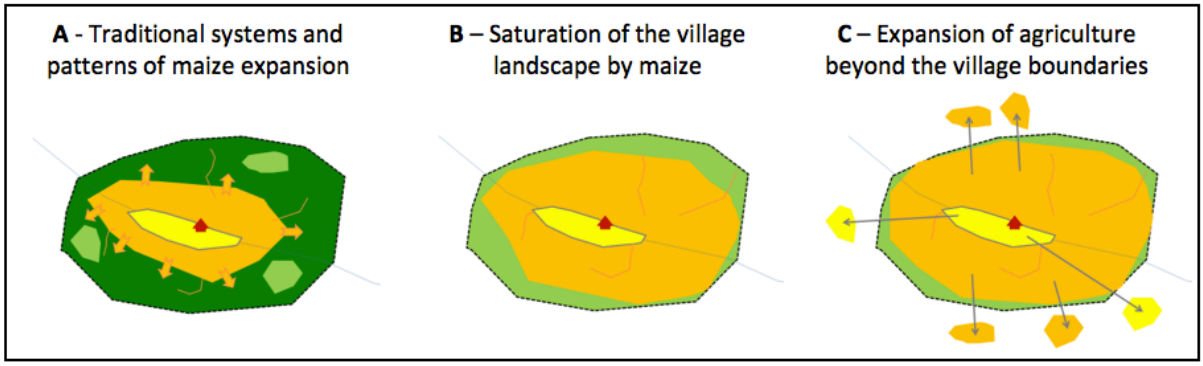
Source: DAFO and village data

The maize boom - recent changes in agricultural systems

In the early 2000s, profound changes occurred to the prevailing agricultural systems in Nonghet District due to the introduction and rapid spread of hybrid maize. Boosted by increasing demand from the bordering Vietnamese market, hybrid maize was introduced by Vietnamese companies with the support of local middlemen and district extension agents. Hybrid maize more than doubled the yields as compared to traditional maize with 5 to 6t/ha harvested against 2 to 3 t/ha with the latter. Maize cultivation spread rapidly after an initial testing stage. Like most innovations, it first expanded in the most accessible villages along the main roads, from Kham District, before reaching the most remote areas. Consequently, villages located in the 'warm areas' of the district (i.e. Nammen, Phakhae Tai, Korthong) had all shifted to the maize crop by 2006, while Pha-En, located 15 km away from the road, started in 2007-2008. The maize area expanded rapidly thanks to changes in agricultural practices: the use of herbicides and mechanical tillage, which considerably lowered labour requirements per unit area.

Maize fields were initially located close to the roads or residential areas to ease transportation. At harvest time, 5 to 6 tonnes of maize ears per hectare have to be carried down the hills manually, compared to 1 to 2 tonnes per hectare of upland rice. As a consequence, maize expanded from the roads and villages centres towards the periphery as harvest transportation was considered a constraint (Figures 4A and 5). To overcome this issue, maize roads were build along the hillsides to facilitate access to hand tractors for transportation. Local middlemen would typically provide this road opening service, together with mechanical tillage with tractor, by contracting villagers who then had to reimburse them over several years. The cost of this type of road was 16 million kip per kilometre in Paka. In some cases, villagers built the roads themselves to avoid debt.

Figure 4. Schematic representation of landscape changes in Nonghet District.

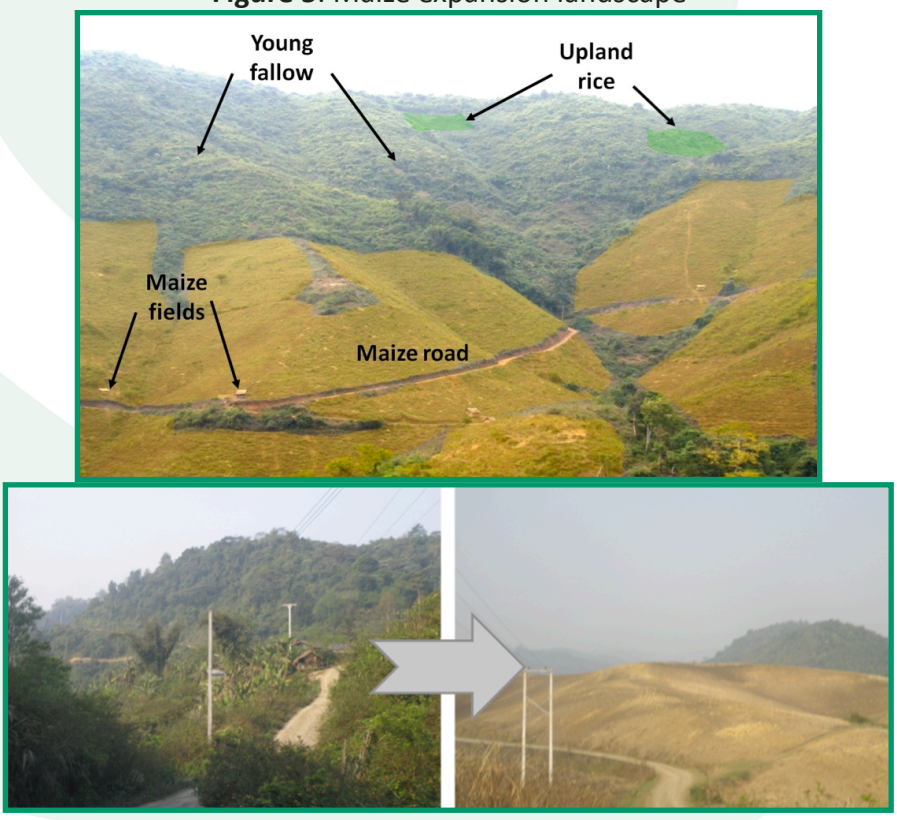


In villages such as Phakhae Tai, maize expanded so much that the landscape became saturated (Figure 4B). The upland crops are not fallowed anymore. In the uplands, the forests, rice swidden, and grazing areas for livestock have gradually disappeared, pushed to the periphery of the village or replaced with maize. Tensions over grazing areas for livestock and damages caused to maize has led many farmers to sell their animals. Even the 6,5 hectares of paddy that were still cropped in Phakhae Tai in 2003 have since been turned into maize.

Changes in land market and land management

Once the territorial limits of the village were reached (Figure 4C), farmers searched for more land suitable for maize, expanding to neighbouring villages and as far as Kham District. Since 2007, land speculation has increased tremendously. First, villages that had earned money from their first maize harvests tried to buy land with official titles, only available for paddies. Villagers in Keopatou and Paka bought paddy land in other villages.

Figure 5. Maize expansion landscape



More recently, in 2009, farmers tried to rent upland fields from other villages to grow maize. In Paka and in Pha-En, villagers complained that their village is too 'cold' for maize. They first got land from relatives in neighbouring villages (also in Keopatou), then had to pay 2 to 3 million kip/ hectare per year under a 3 year contract. The Paka villagers would have preferred to buy land, but it was not possible in their case because the village head did not want to officialise the land sale and the elder committee in the neighbouring village did not authorise villagers to sell their land to outsiders. In Pha-En, some villagers bought land from a neighbouring village for 10 million kip per hectare. In Phakhae Tai the land the price for maize rose from 300.000 kip/ha in 2006 to 7 million kip/ha in 2009 and 10 million kip/ha in 2012. Then land sales ceased, as no one wanted to sell land in the village.

Pha-En villagers involved in the focus group discussion described that 40% of the total maize production is cropped within their village territory and 60% in produced in other villages. 90% of the villagers who crop maize outside Pha-En village bought the land while only 10% rent it. The rental fee is becoming too expensive due to recent speculation. Therefore, most farmers prefer to buy whenever possible (see land sale certificate in Appendix 2), although the purchase price is rising rapidly, with plots that were sold for 10 million kip in 2008 sold for 20 million kip in 2013. The trend has been similar for paddy land; the price (50 million kip/ha) has doubled in the last decade from 25 million kip per hectare sold in 2002-2003 in Pha-En or Keopatou.

The rapid maize expansion triggered major changes in land management, especially in relation to livestock movement around the village landscape. A range of situations can be found in the surveyed villages depending on the characteristics of the landscape, the percentage covered by maize and, how villagers responded to the pressure imposed by maize on the land traditionally dedicated to animal grazing. For the sake of simplicity, they are categorised below as three main shifts in land management, but in reality, a complex gradient of local land management rules is found in the villages.

Communal grazing areas: from roaming to parked (or tended) livestock

Land use planning and delineation of village livestock is usually the first reaction to increasing pressure on traditional pastures that are spread over the whole village landscape. Under maize pressure, all of the villages have delineated and fenced off livestock areas. In Keopatou, for example, each family has to fence 40 meters of the collective livestock area.

However, none of the villages is growing grass in the collective area, as this would require more collective organisation. The livestock areas are thus large areas with native grasses, where the animals are tended during the cropping season to avoid damages to the crops.

Improved pastures: growing grass on private land

Improved pasture practices are only practiced individually on private land. Elephant grass (ຫຍ້າ ອ້ອຍຊ້າງ or ຫຍ້າ ເນ ເປຍ = Napier grass) is grown in Paka, Pha-En, and Keopatou by villagers who want to keep raising livestock, despite the decreasing area under natural pasture (Table 4). Some farmers in Pha-En or Keopatou have grown grass for many years. They acquired seedlings from a livestock farm in Phonesavanh, and they gradually expanded their growing area under a cut and carry system. This system requires more labour than letting the animals graze freely in the improved pasture, but it prevents damage to the pastures.

However, the surveyed villagers indicated that they do not use the manure produced by parked animals as the stalls are too far away from the paddies, they don't have enough manure to fertilise maize, and they don't feel the need, as the yields are still stable.

While challenging in some villages, maintaining a cattle herd in the face of increasing maize areas is culturally grounded in H'mong villages. There is a strong tradition of fattening cattle and breeding fighting bulls.

Decreasing size of livestock herds

In some villages, such as Phakhae Tai, Nammen, or Korthong, the pressure was considered too high when cattle owners were forced to pay a fee of 250 kip/maize plant to the owner of a damaged maize plot. Within a few years, maize expansion deeply transformed land management rules from upland farmers being considered responsible for livestock damage to their crops because they were not properly fenced, to livestock owners being considered responsible for the damage to maize crops because their animals were not tended or parked. The shift from fenced maize to fenced livestock led many farmers to stop raising livestock, as they did not have a big enough labour force to tend livestock, or they preferred to allocate their labour force to maize expansion, which provided a more rapid return on labour investment.

Figure 6. Recent changes to livestock herds in surveyed villages

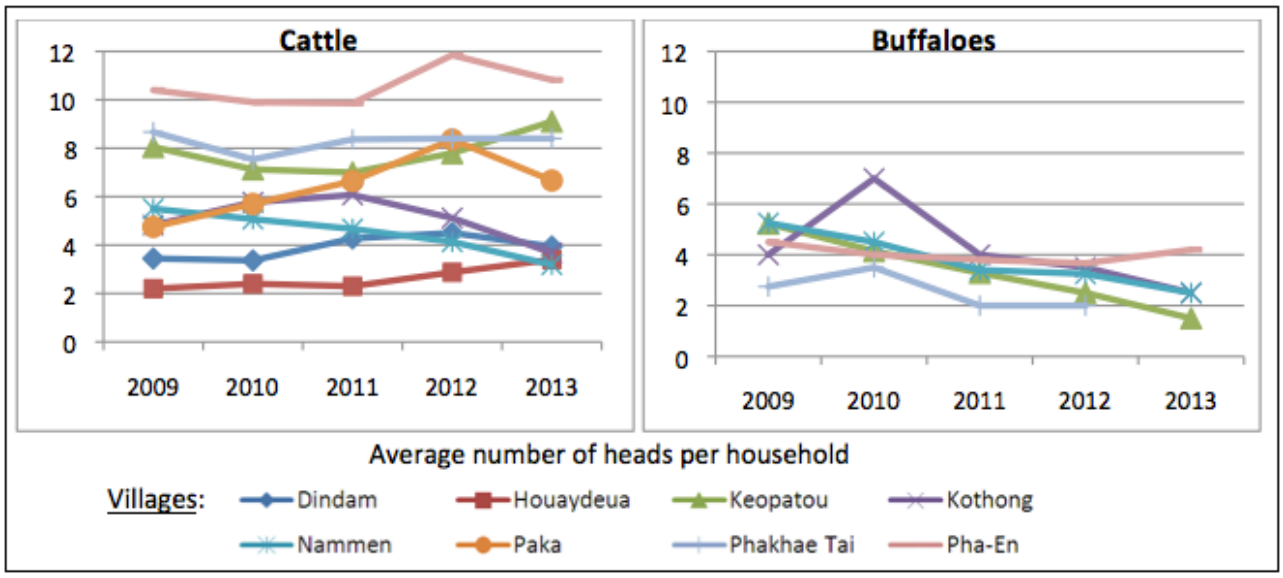


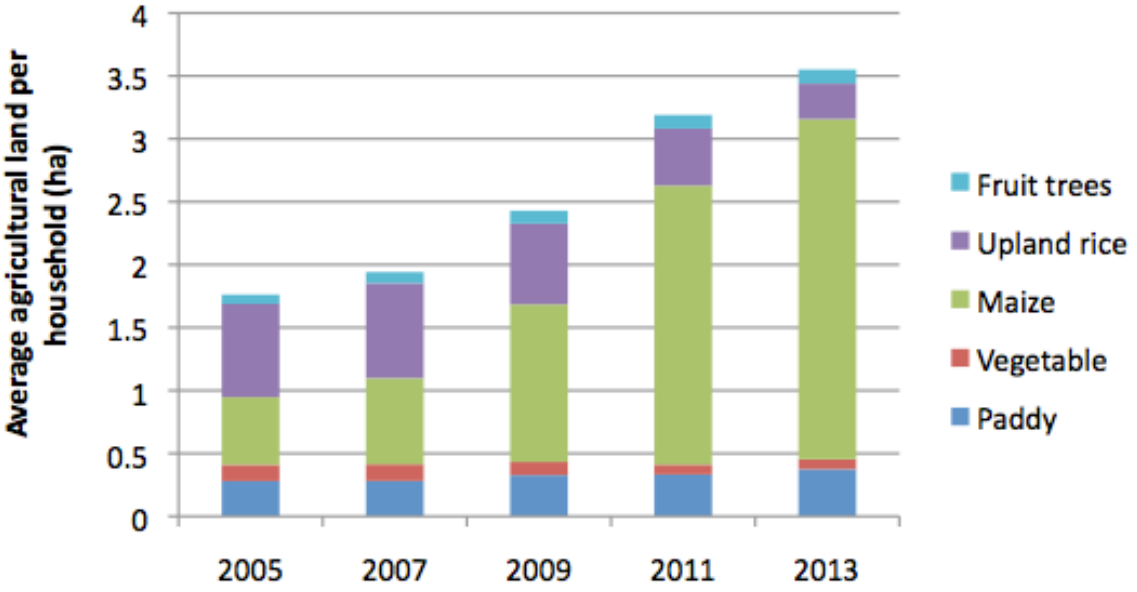
Table 4. Livestock numbers in the surveyed villages - 2013 (*Source: DAFO and village data)*

Village	Cattle	Buffalo	Goat	Pig	Poultry
Keopatou	240	30	25	120	2000
Nammen	118	22	0	130	873
Phakhae Tai	325	14	128	296	3390
Korthong	109	11	7	85	589
Pha-En	648	65	0	432	4104
Dindam	144	0	11	45	124
Houaydeua	50	0	0	16	150
Paka	150	15	50	50	200

Agricultural expansion, intensification and specialisation

On average, the cropped area per household doubled during the past decade, from 1.8 ha to 3.6 ha (Figure 7). Household level data show an overall increase in agricultural areas, a rapid expansion of maize areas, and a decrease in upland rice cultivation (Appendix 3).

Figure 7. Agricultural expansion over the last decade



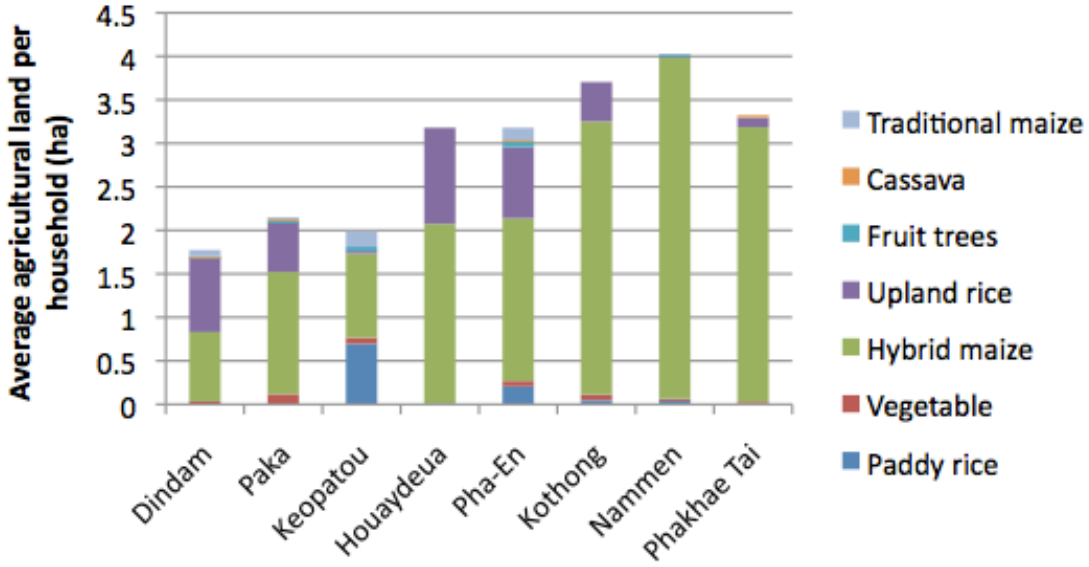
Source: Household surveys 2009 and 2013 in Phakhae Tai, Nammen and Keopatou villages.

From 18 crops registered in 2005[1] in Phakhae Tai, Nammen and Keopatou villages, only 8 were still cropped in 2013 (bold in the note below). In the most accessible villages, under the influence of the maize boom, farmers said that they no longer have time for "minor crops that take a lot of time but do not contribute to the household income." In Nammen, for example, only 5 crops have been reported in 2013. Hybrid maize is produced by 100% of the surveyed households, while paddy and upland rice are grown by about 10% of the households, and the 3 last (leafy vegetables, peanuts and bananas) are cropped only by one household out of the 30 households that were surveyed (Figure 8). In more remote villages, like Pha-En and Keopatou, the cropping systems are still diversified, with 12 crops grown, but the observed trend is towards a gradual specialisation, as farmers get equipment specific to maize cultivation.

The disparities in the average agricultural area per household between villages, i.e. from less than 2 hectares per household in Dindam to more than 4 hectares in Nammen, reveal different stages in the process of agricultural intensification through changes in cropping practices. The rapid expansion of maize areas in Korthong, Nammen and Phakhae Tai was associated with the use of herbicides, mechanisation of land preparation, and construction of maize roads on the hillsides that were allowed by the gentle slopes of the landscape. On the left side of Figure 8, Dindam and Paka villages, while located along the main road with good accessibility, are still practicing manual agriculture due to steep slopes that do not allow for mechanical tillage. Due to cooler temperatures and receiving less sunshine than the western part of the district, these villages did not develop maize cultivation as much as the other villages located in the right hand side of Figure 8. As a result, their agricultural practices are more diversified and maize represents a lower percentage of their total agricultural land. The fact is that all villagers would like to engage in intensive maize cultivation, but some are constrained by their agroecological environment.

[1] Fruit trees, Bananas, Leafy vegetables, Maize (Traditional), Cassava, Upland rice, Maize (Hybrid), Paddy rice, Chili, Garlic, Peanuts, Sugarcane, Onions, Pineapples, Pumpkins, Long beans, Sweet maize, Soybeans.

Figure 8. Average cropping area per household in surveyed villages in 2013



Source: Household surveys.

Over a single decade, agriculture was completely transformed by the maize boom. Key changes in cropping practices allowed for major gains in productivity that were reinvested in expanding the production areas. The whole process started with the introduction of hybrid maize from Vietnam, which could double the yields obtained from traditional maize cultivars. In addition, maize is very easy to grow and less perishable than other crops that require rapid processing after harvest (e.g. sugarcane, vegetables) providing flexibility for the harvest to be spread over a long period. These 'intrinsic qualities' of the crop, and especially the hybrid cultivar, were initial factors at the origin of the "maize boom."

A second factor was the rapid intensification of maize production through major changes in cropping practices brought by external agents: e.g. introduction of herbicides, mechanisation of land preparation, building on maize successes in other provinces of Laos (e.g. Sayabouri, Oudomxay) and neighbouring countries (e.g. Vietnam, Thailand). Maize cropping practices can be categorised according to their degree of intensification. The six categories (from A to F) presented here below and represented in Figure 9 in relation with their labour requirements, can be found in the different villages of Nonghet as they are at different stages in the maize intensification process.

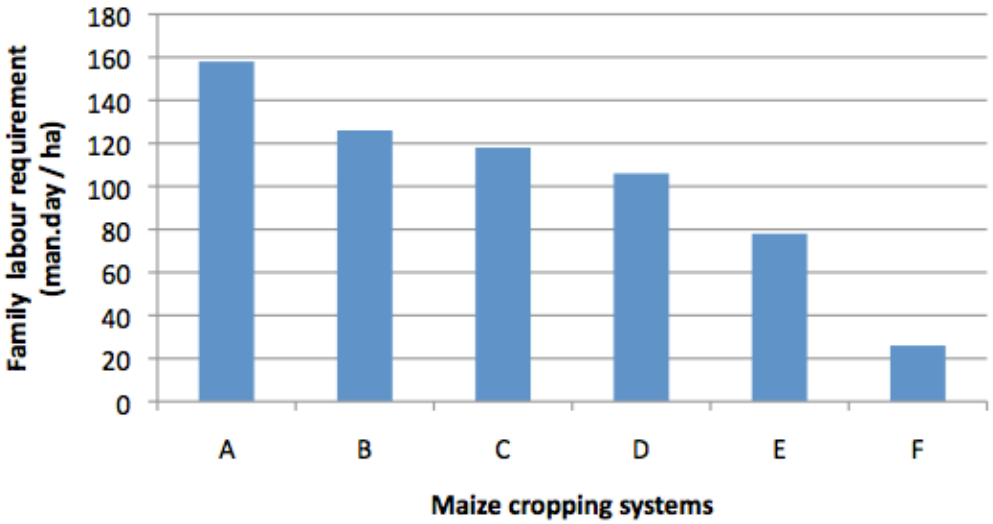
- **A.** Traditional slash and burn systems consist of slashing and burning a 3 to 5 year old fallow then sowing and weeding twice manually with a hoe. The harvest and transportation are also done manually.
- **B.** Slash and burn on a 1 to 2 year old fallow leads to lot of weed re-growth in the early rainy season, which is controlled by an herbicide spray at sowing. Contact herbicide such as paraquat or 2,4D – now forbidden to use because of high toxicity (but still used illegally because of their cheap price) - have been replaced by the more expensive glyphosate. Manual knapsack sprayers are used. The second weeding is manual, like all other practices.
- **C.** Slash and burn of young fallow combined with the use of a motor pump (instead of a manual sprayer) to save time on herbicide spraying. Two people are necessary to handle the 180l water tanks, the motor pump, and its long hose. Non-selective (kills all vegetation) glyphosate herbicide is applied at sowing, while a selective atrazine herbicide (kill weeds but not maize) is sprayed after maize seedlings have grown up.
- **D.** The maize field is cropped every year. The absence of fallow leaves very little residue to slash and burn but creates a lot of weed control problems. Mechanical tillage with disks mounted

on a large tractor is used for land preparation. As a consequence, only little herbicide is used at sowing and the second weeding is done manually with a hoe.

E. When the weed pressure becomes high due to the absence of fallow or crop rotation, mechanical tillage is combined with 2 sprays of herbicide (glyphosate at sowing and atrazine after crop emergence) with motor pumps. The cropping system is completely mechanised from land preparation: slashing with a motor weeder and tillage with a tractor, herbicide sprays with a motor pump, and water and harvest transportation with hand tractor or small truck.

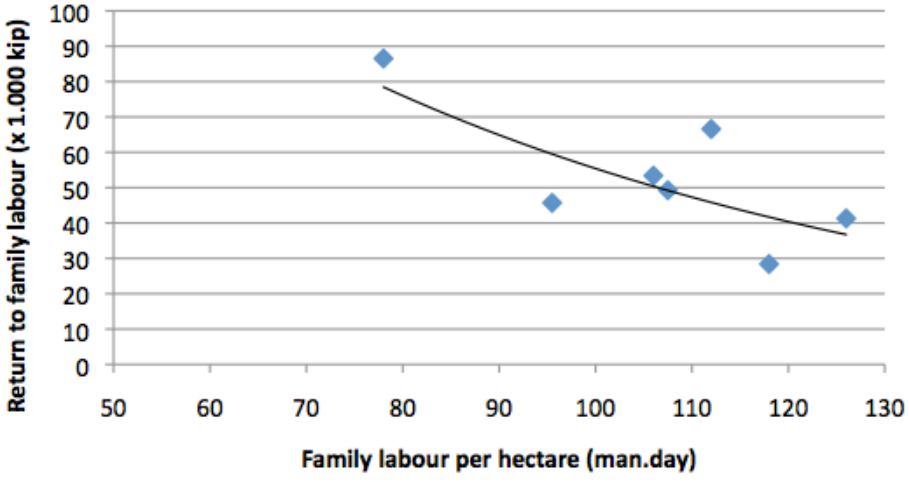
F. The next stage of labour intensification consists of hiring daily workers (50.000 kip/day) for all technical operations. After mechanisation of the cropping system is completed, a limited family labour force becomes a constraint to maize expansion (Figure 10). Family members then become supervisors and participate in the cropping practices, but most activities are implemented by wage earners (young people from the village), like in Phakhae Tai and Nammen.

Figure 9. Labour requirement per ha maize under different practices



Source: Focus group discussions 2013 (see Appendix 4)

Figure 10. Gain of productivity (return to labour) with decreasing family labour requirement

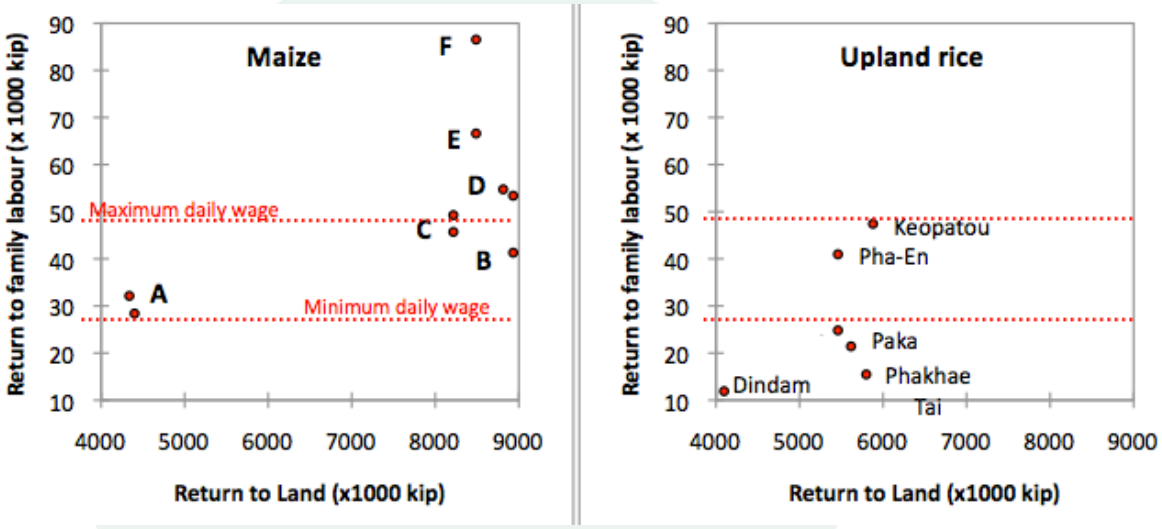


Source: Focus group discussions 2013 (see Appendix 4)

With the gradual reduction of labour requirements, these cropping systems also represent the successive stages in agricultural intensification that villages such as Nammen and Phakkhae Tai went through.

Some of the innovations brought by maize, like herbicide use, were reinvested in other crops (e.g. upland rice) in areas that were not suitable for maize (Figure 11). These innovations led to increased productivity in all production or abandonment of less productive activities (i.e. specialisation).For example, Figure 11 shows that upland rice is still economically viable in Keopatou and Pha-En, where herbicide is being used, while it is was not economically viable in Phakhae Tai, where the land is degraded in the absence of fallow, or in Dindam and Paka because of a poor climatic season in 2013 (a typhoon from Vietnam) that did not allow proper rice grain filling and reduced the harvest to almost nothing in Dindam.

Figure 11. Crop productivity changes in Nonghet



Source: Focus group discussions 2013 (see Appendix 4)

Agricultural intensification through introduction of new practices was a key element of agricultural expansion, as farmers invested the time saved for each hectare of maize into increasing the number of hectares cropped. Agricultural intensification also led to agricultural specialisation, as farmers did not want to invest anymore of their valuable time in low return activities. These two processes fed the "maize boom" and presently make it very difficult for farmers who are "surfing the maize wave" to think about anything other than maize. They know that their current practices are not sustainable but they don't know about alternative productions that would be as lucrative as maize (Source: focus group discussions in Phakhae Tai and Pha-En).

The favourable economic environment is the third factor behind the maize boom, after the crop quality and changes in cropping practices. A rising market demand for feedstock in neighbouring countries has sustained high prices over a long period. After a short price drop in 2008 due to the global financial crisis, maize prices rose again in recent years. Traders and middlemen have actively supported maize expansion by providing agricultural input on credit with reimbursement at harvest. In addition, poverty reduction policies supported by the Government of Laos (GoL) have provided low interest rate loans, also contributing to the rapid expansion in the 2000s of a crop that was traditionally grown by farmers in Nonghet. In 2013, the 7% interest rate on short-term loans for maize production was been brought down to 5%.

The analysis of agriculture in Nonghet District shows the overwhelming role of the “maize boom” in land use changes and in farmers’ decision making. This situation cannot be neither ignored nor avoided in order to provide relevant recommendations to overcome the issues faced by farmers in Nonghet, which will be described in the next section IV. This led us to introduce the idea of successive stages in the “maize boom”: before, during, and after, with recommendations adapted to each of these three stages (see Section V).

Figure 12. Maize-driven innovations: hybrid seeds, herbicides and motor pumps

IV. Impacts of Agricultural Changes on Livelihoods

"Maize made us rich but it may also make us poor."

This is the how the vice-head of Phakhae Tai Village introduced the discussion about the impact of agricultural changes on livelihoods during the focus group discussion held on March 19, 2014. Indeed, household data collected in Phakhae Tai shows how fast the village economy has developed over the recent years, thanks to maize production. More cars, trucks and other material assets, both domestic (e.g. TV sets, fridges, mobile phones) and productive (e.g. herbicide sprayers, hand tractors and big tractors), are owned by villagers. Livelihood improvements are also obvious from both data analysis and direct village observation, such as the shift from wooden to concrete houses. Perceived positive changes are numerous (Appendix 5), such as the use of additional income to provide better education to children or better diet (i.e. with more meat). But the focus group discussion showed that villagers are also worried that the success may not last long and may have lasting negative impacts. Two main areas of concern that have been pointed out by participants are environmental and social changes. Villagers are concerned about the negative effects of agricultural expansion on deforestation and forest degradation, of maize mono-cropping on erosion of soil fertility and biodiversity, and of the intensive use of herbicides on water contamination and human health. They now have to endure 5 long months of water shortage every year, which create increasing tensions among villagers. Beyond the environmentally-born social tensions, the increasing income disparities are also causing strains. While the overall village has been lifted out of poverty, the inequalities have increased over the years. The rich are getting richer and the poor have no other options other than working for the better-offs or leaving the village, as their traditional livelihood systems based on subsistence farming are not possible anymore due to the shrinking natural resource base. People are becoming more individualistic and social capital is gradually dissolving with, for example, the shift from mutual help to daily wage workers, or poor attendance at village meetings and collective works. The village head of Phakhae Tai had to set-up a system to ensure that villagers would attend village meetings. Villagers have to send one family member to each village meeting with a booklet that is signed and stamped by the village head at the end of the meeting. Households that cannot show the stamped booklet must pay a 20.000 kip fee per missed village meeting. As a consequence, meetings are mainly attended by women with young children and elder men as their opportunity cost may be lower than the one of active adults in the village.

This short introduction based on the case of Phakhae Tai village generally summarises the overall development issues faced by villagers in Nonghet District and also beyond, in the northern uplands of Lao PDR.

Livelihood changes

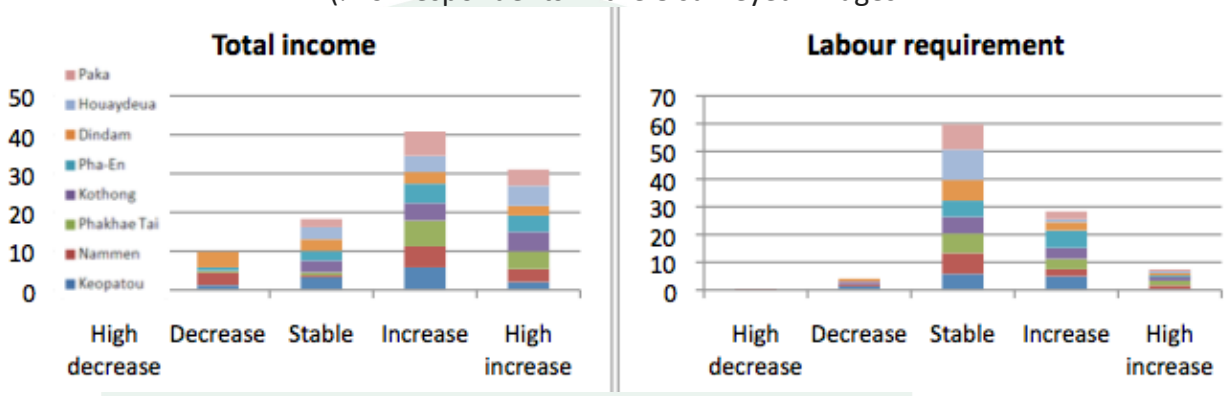
Livelihood changes in Nonghet District were analysed based on three sources of information:

1. Individual villagers' perceptions of livelihood changes over the last 5 years, using a ranking system from high decrease, decrease, stable, increase up to high increase (Appendix 5), and perceived changes in household expenditures, also using a ranking system from 0 (no expenditure) to 5 (high expenditure) as shown in the questionnaire (Appendix 1), and results of the qualitative survey (Appendix 6),
2. Data about the current status of villagers' livelihoods in the 8 partner villages. As the villages are characterised by different levels of accessibility and integration to market, time can be substituted for distance to consider that the varying gradient of village accessibility reflects land use change over time, for example in villages that went through all stages of agricultural intensification.

3. Through additional qualitative questions, focus group discussions conducted in 4 villages addressed the issues that were identified during the literature review followed by the household surveys. The feedback received from participants at the restitution workshop organised on March 21, 2014 has also been incorporated in the results below.

Figure 13 shows the perceived increase in total income across villages over recent years (except for Dindam, which experienced very poor yields in 2013). It shows a general improvement in overall income of villagers but also an increase in labour requirements, which is consistent with the livelihood changes described by focus group participants. The shift from subsistence to commercial farming and the expansion of agricultural land is associated with an increase in the overall workload despite rapid mechanisation of agriculture.

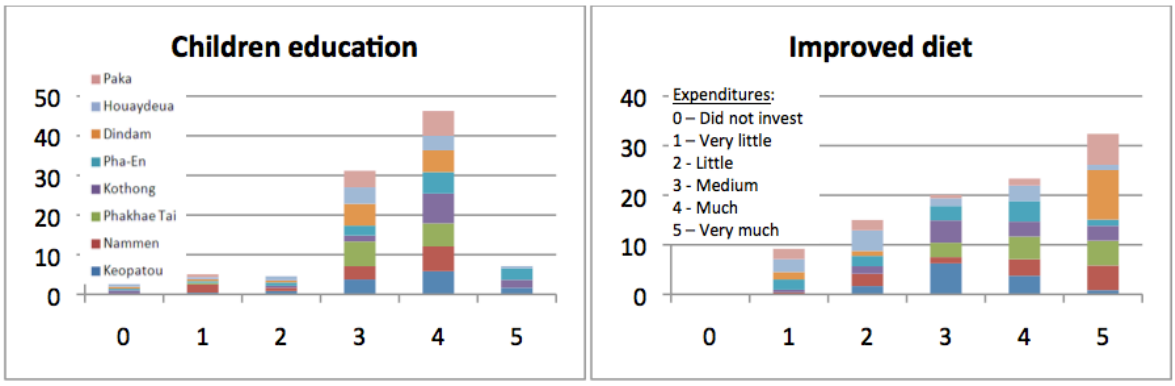
Figure 13. Perceived changes in livelihoods over the last 5 years
(% of respondents in the 8 surveyed villages



Source: Household surveys 2013 (see Appendix 1 & 5)

The increase in income is invested mainly in children's education (Figure 14), improved diet with more meat but less forest products, and, to a lower extent, in agricultural investments and domestic equipment (Appendix 5). While these aggregated results look very positive in terms of livelihood improvement, a closer look at the household surveys shows a large range of situations with a widening gap between the poor households who remain essentially subsistence-based shifting cultivators, and the better-off households, who diversify their activities from commercial agriculture and generate an increasing share of their income through off-farm activities. As a consequence, rice sufficiency, an indicator used to assess poverty in subsistence-based economies, is not relevant in the case of Nonghet District, which is rapidly integrating into the market economy.

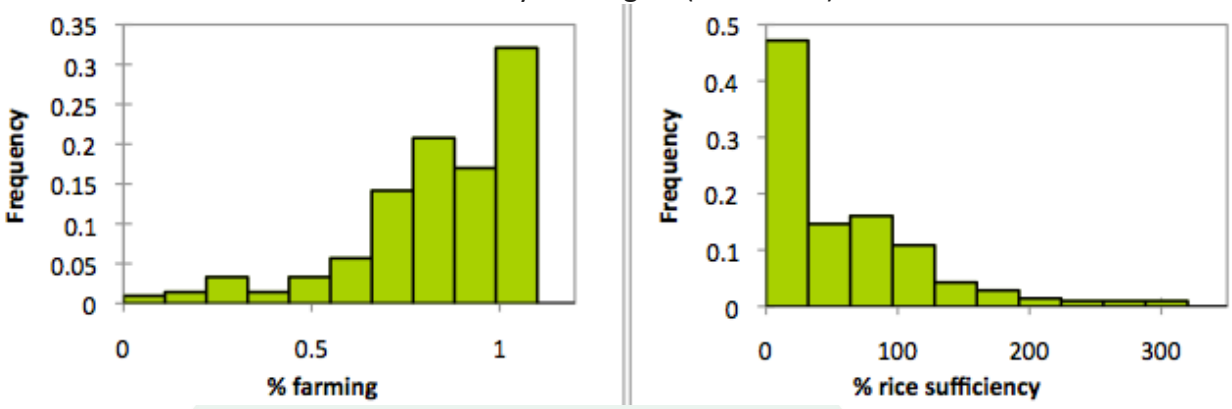
Figure 14. Perceived changes to household expenditure over the last 5 years
(% of respondents in the 8 surveyed villages)



Source: Household surveys 2013 (see Appendix 1 & 6)

The two histograms in Figure 15 show that a large majority of villagers consider themselves as farmers (more than 50% of the time dedicated to farming activities) but that also a large majority do not produce sufficient rice to cover their needs: % rice sufficiency < 100% in the histogram on the right hand side.

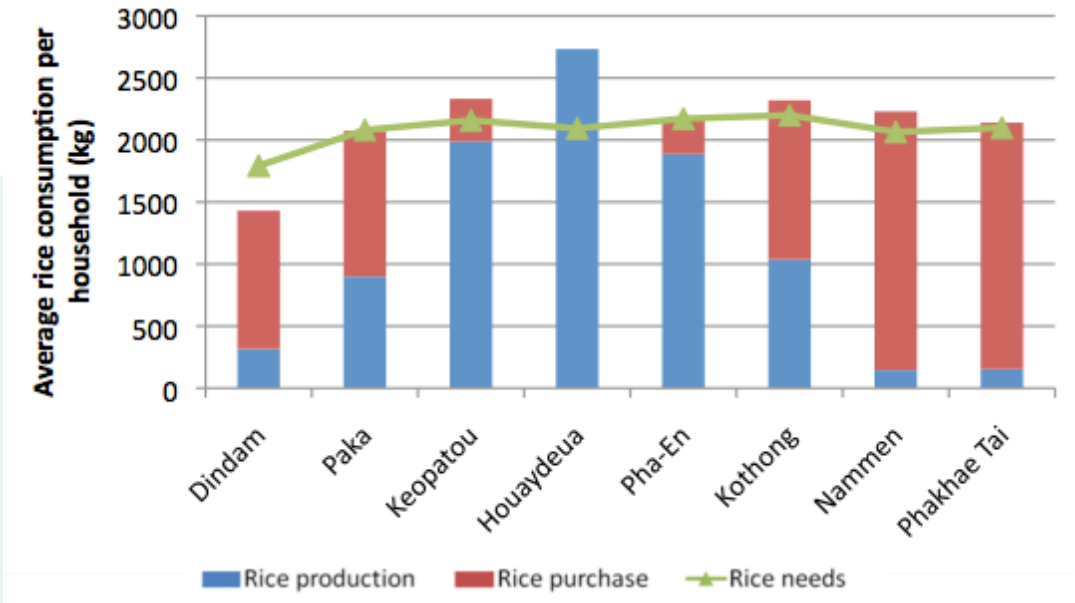
Figure 15. Histogram of percentage of farming activities (left) and rice sufficiency (right) of surveyed villagers (total #212)



Source: Household surveys 2013

The graph in Figure 16 shows different livelihood strategies at the village level. Poor villages like Dindam and Paka have shifting rice cultivation as their main subsistence base, but rely on other production (e.g. livestock) and off-farm activities to generate cash income to buy rice to meet their consumption needs. More traditional, less accessible, villages such as Keopatou, Houaydeua and Pha-En try to reach rice sufficiency through their own agricultural production and generate supplementary cash income from other activities. The third livelihood strategy consists of abandoning rice production, as in Nammen and Phakhae Tai, to concentrate on income generating activities such as maize or off-farm jobs, with a return on labour higher than rice.

Figure 16. Average rice production and rice purchase to cover rice needs per household



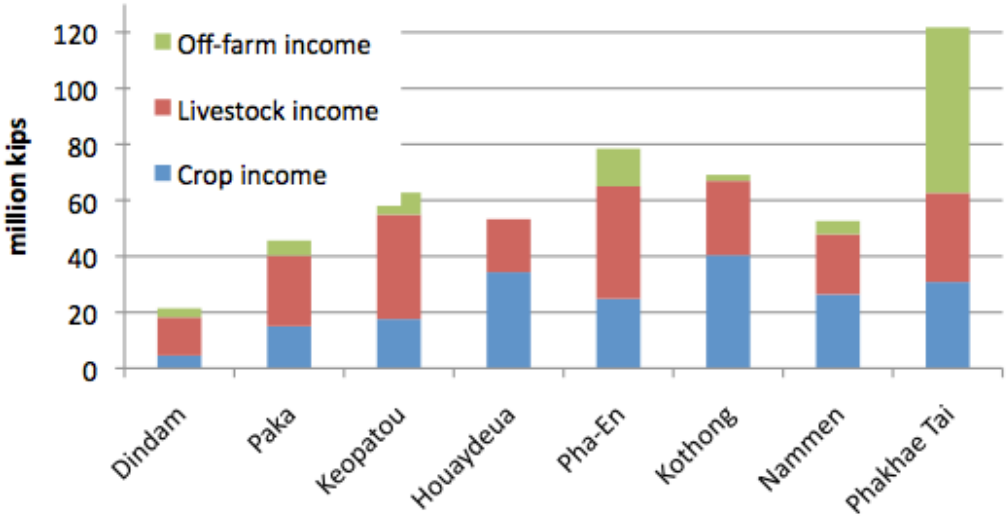
Source: Household surveys 2013

These village level livelihood strategies also reflect those found across households within each village. Indeed, rice insufficient farmers can be among the poorest, those who are limited in terms of suitable agricultural area or labour force, or the richest, who have made the deliberate choice of commercial agriculture and who buy the rice they eat. Often, the former work as daily wage workers for the latter, as in Nammen and Phakhae Tai.

Besides maize, local livelihood systems are organised around traditional income generation activities with livestock coming right after maize, then livestock-related crops such as cassava, traditional maize, and grass. Vegetable, sugarcane and fruit trees are mainly reported for family consumption in the household surveys. However more in-depth discussions with villagers showed that large amounts can be sold by some villagers (e.g. plums and peaches) generating substantial revenues.

Figure 17 shows the distribution of average household income per activity: crop production, animal husbandry, and off-farm activities. The income from crops was computed based on the average market prices, considering that all the production is sold and generates cash income. In reality, part of the production is used for self-consumption. The calculation of livestock income per household is detailed in Appendix 7. The income distribution of all surveyed households per village is shown in Appendix 8. These results show the important role of livestock in local livelihoods despite the rapid expansion of maize in the recent years. Livelihoods in Keopatou and Pha-En rely very much on livestock. Similarly, at the two extremes of Figure 17, Dindam and Phakhae Tai also largely rely on livestock as a safety net in case of a poor cropping season, for those households who still have agriculture as their main income-generating activity.

Figure 17. Distribution of average household income per activity and per village

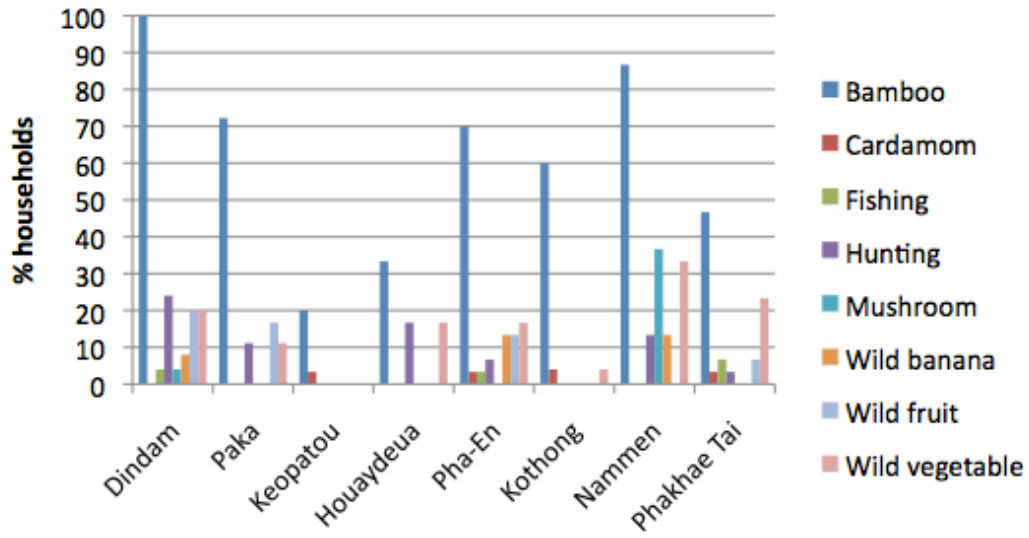


Source: Household surveys 2013

However, focus group discussions showed that there is still room for improvement in livestock systems. The extensive livestock management system creates a lot of tensions with upland crops, as discussed above. In addition, livestock mortality is very high (around 20% of young animals die before 1 year) and loss of roaming animals is frequent. In 'livestock villages' animal vaccinations seem more systematic than in other villages, thanks to past systematic vaccination campaigns, and multiple livestock projects. In other villages, farmers vaccinate when the animals show symptoms of disease, which is often too late to save them.

Collection of non-timber forest products (NTFP) has sharply decreased in recent years, but this activity is still important for family consumption. Forest products make up a large part of the diet, especially bamboo shoots, which are collected in all villages, as shown in Figure 18. Very little NTFP are sold. NTFP are an important safety net, especially for the poorest villages, such as Dindam and Paka. Villagers in Dindam intensified NTFP collection and also worked as daily workers to load and unload trucks at the Vietnamese border when their upland rice harvest failed in 2013.

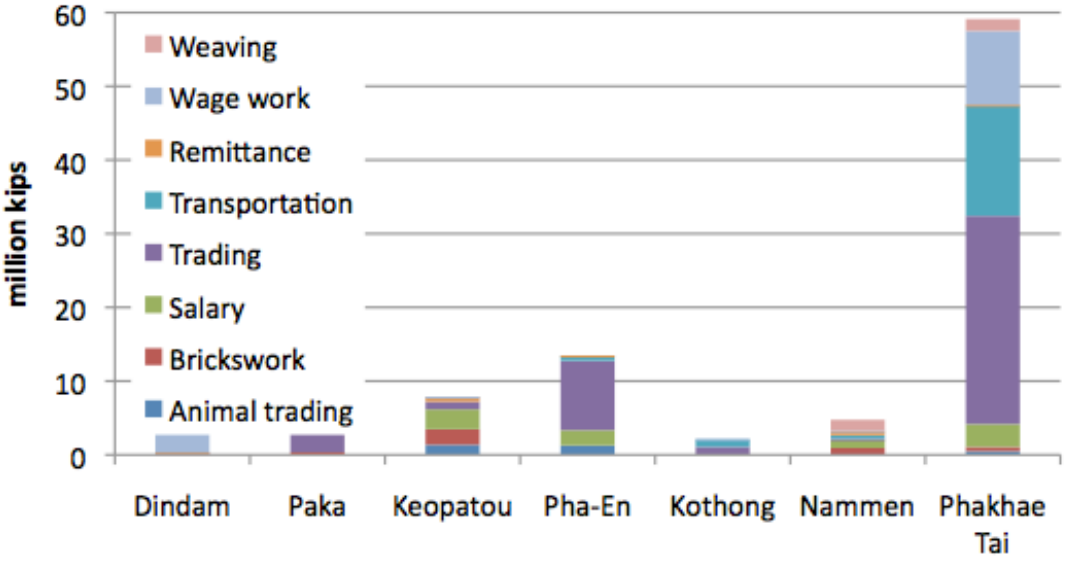
Figure 18. Household collection of non-timber forest products



Source: Household surveys 2013

Last, but not least, a few households in Phakhae Tai, and to a lower extent in Pha-En, generate most of their income from off-farm activities. They have reinvested their agricultural income in trading activities or have bought tractors and/or trucks and provide tillage or transportation services to other villagers (Figure 17). These village entrepreneurs contribute to the economic development of their village as they integrate into the market economy.

Figure 19. Average off-farm income per household



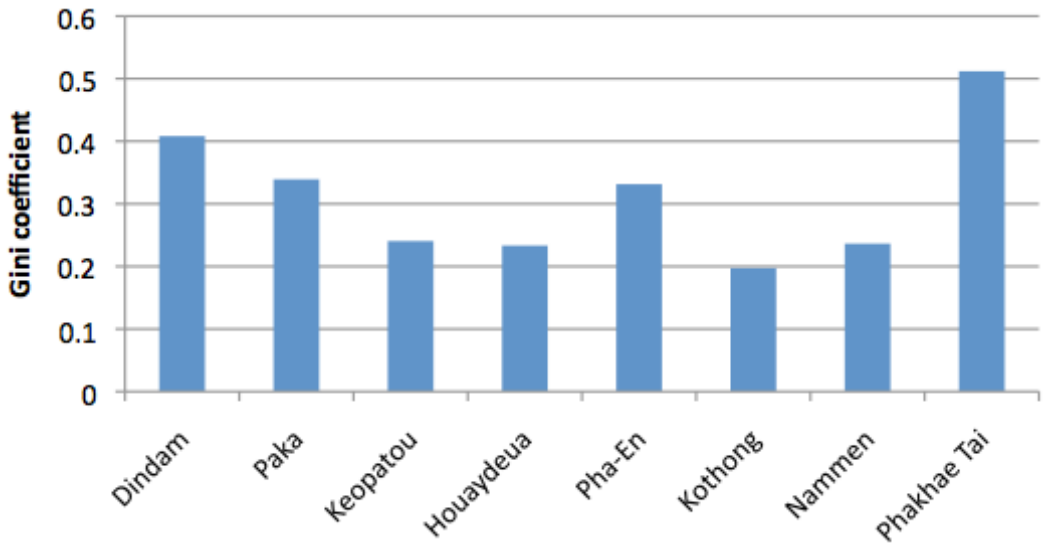
Source: Household surveys 2013

Unexpectedly, Dindam village, which is located very close to the Vietnamese border, does not really benefit from this proximity beyond daily wage work opportunities loading trucks. Reports on livestock trading in the area show that many animals from Xieng Khouang Province transit through this village and that many livestock traders are active in this area. Beyond the detailed study by Bourgeois-Lüthi (2010) a more thorough investigation into local implications of livestock trade would be interesting to develop, in order to understand how local villagers could better reap the benefits of their proximity with a major trade portal.

Beyond the income disparities across households within each surveyed village, shown in Appendix 8, we computed the Gini coefficient of each village. The Gini coefficient takes values between 0 (perfect equality) and 1 (total inequality). Increasing values of the Gini coefficient reflect increasing inequality in income distribution among households. This indicator captures the shape of the income curves in Appendix 8 into a single value. Figure 20 shows again three main types of villages that also correspond to three main types of households within Nonghet villages.

- On the left hand side, the poorest villages are characterised by limited access to suitable land and resources for agriculture. A tough landscape and adverse climatic conditions (i.e. cool winter temperatures with limited sunny days) impose significant constraints to agricultural development. Farmers who do the best in such difficult environments usually invest on livestock (Appendix 8).
- Villages in the middle of the graph benefit from a large natural resource base that increases their range of available agricultural opportunities. However, their access to market is limited by their accessibility (i.e. distance to the road and quality during the rainy season). They combine traditional, subsistence-based agriculture with new income opportunities such as maize – including by renting land in neighbouring villages with more favourable biophysical environments – and commercial production of livestock, vegetables (Keopatou used to be famous for its asparagus production introduced by a project) and fruit trees.
- Villages on the right hand side have reaped the benefits of their favourable biophysical environment and easy access. All households have engaged in the same production and changing landscape management rules have been imposed to the whole village (e.g. tending or selling livestock). They are reaching the end of the maize boom and are actively searching alternatives to overcome rising environmental, economic and social issues. Income disparities reveal these different choices with better-off households investing off-farm.

Figure 20. Income disparities within surveyed villages

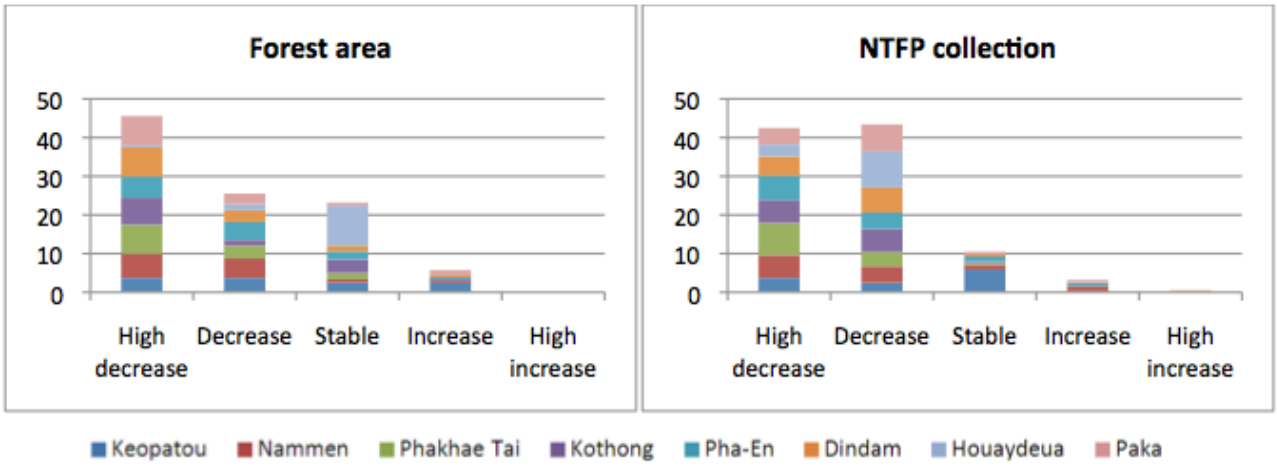


Source: Household surveys 2013

Environmental degradation

Two processes of environmental degradation are at work in Nonghet District, with one more clearly perceived by villagers than the other. The first process is related to agricultural expansion leading to deforestation and forest degradation, soil erosion and water shortage. The first stages of this process are perceived in all villages in the form of loss in forested areas and reduced availability of NTFPs (Figure 21).

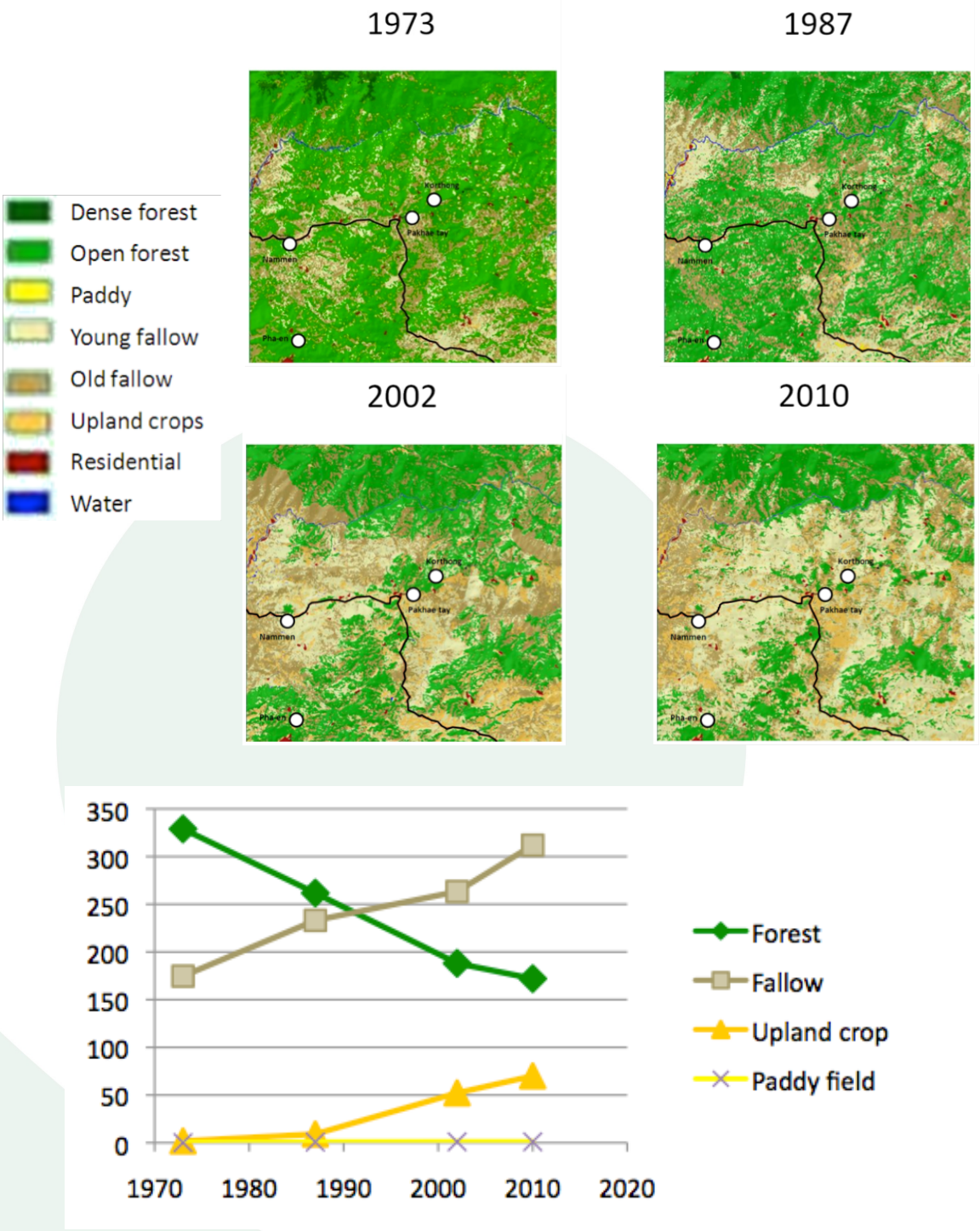
Figure 21. Perceived change in forest area and forest products over the past 5 years (% of respondents in the 8 surveyed villages)



From there, soil erosion and decreasing soil fertility are associated by farmers with reduced upland rice yields during individual household surveys (Appendix 5). However, in villages such as Pha-En or Keopatou, the negative impact of land degradation on maize yield is not yet perceived, while in Phakhae Tai or Nammen villagers reported serious erosion problems that started about 3 years ago due to repeated tractor tillage. As mentioned above, there is a clear gradient of perceived land degradation in relation to the successive stages of the maize intensification process. At the end of the degradation gradient villagers also mentioned water scarcity as an emerging problem, with rising tensions among water users (Phakhae Tai).

These results are consistent with the analysis of land use change and impacts on forest cover conducted in 2010 in Nonghet District, based on a time series of Landsat satellite images (Figure 22, Kongay et al. 2010). Over the last decades the forest has gradually disappeared from the landscape around Nammen, Korthong and Phakhae Tai, with a shortening of the fallow period and expansion of upland crops. The trends expressed by villagers through participatory approaches are thus confirmed and quantified based on remote sensing data. Unfortunately these changes are irreversible and forest re-growth will never recreate the ecological environments that prevailed before the past decade of rapid agricultural expansion. However, it may be possible to recreate complex landscape mosaics similar to those that still exist in villages like Pha-En or Keopatou, but that are under threat of degradation. Innovative landscape approaches combined with supportive policies may be able to create an environment enabling agricultural diversification, biodiversity enhancement, and preservation of soil and water resources.

Figure 22. Land use changes from 1973 to 2010 in the northeast of Nonghet District.



Source: Kongay et al. 2010

The second, less visible, environmental degradation pathway is related to the intensive use of herbicides with potential negative effects on the environment (e.g. soil and water contamination, invasive species) and on animal and human health. Again, the initial elements of this second pattern of environmental degradation are perceived by everyone, such as the use of herbicides (Appendix 5). However, the negative impacts on water contamination or human health are only perceived by those villages that are far enough in the degradation process, such as Phakhae Tai.

There, unlike in other surveyed villages, some villagers felt dizzy after herbicide application.[2] Perhaps more impacts would be observed if more systematic measurements (e.g. water source pollution, health monitoring) were in place. In the absence of monitoring or awareness campaigns villagers do not consider herbicides as a problem, as long as they do not spray herbicides close to water sources and do not wash herbicide tanks in the rivers.

It is obvious from these results that villagers will be more reluctant to engage in environmental preservation and/or restoration activities unless they are fully conscious of what is going on, and the risk they run in the short, medium, and long terms. A combination of well-coordinated activities should therefore be advanced:

i. monitoring changes in the quality of the environment, livelihoods, and health, with meaningful indicators for both villagers and development actors,
ii. awareness campaigns through education of adults and children (also by involving them in participatory monitoring activities) and
iii. identification of interventions adapted to the 3 stages of environmental degradation processes as identified here above.

However, when asking villagers what they would be willing to do to preserve their environment and livelihoods on the long term, their response was:
"If you have ideas how to restore fertility without fallows, we, villagers are ready to follow your advice. We know that our practices are not sustainable, we would like to change, but we don't know what to change and how to change."
(Source: Focus group discussions in Pha-en and Phakhae Tai)

Scenario explorations

Different options for livelihood improvement were explored collectively during focus group discussions in four villages: Pha-En, Keopatou, Phakhae Tai, and Dindam, and then again with representatives of the 8 surveyed villages and district technical services (DAFO and DoNRE) during the restitution workshop held on March 21, 2014 at the Nonghet District administration office.

These scenarios are presented below as a combination of short-term and long-term solutions to overcome issues identified during the diagnostic study. These issues are all related to the recent maize boom and can be summarised as follows:

- The maize boom is at **different stages** depending on the villages / field **accessibility** (e.g. Pha-En) and **agroecological conditions**: soil quality, steepness, local weather temperature, rainfall, sunshine (e.g. Dindam),
- There is a spectrum of local situations and farming systems in relation to the three main stages of the maize boom:
  - **pre-maize boom** characterised by a mix of traditional subsistence farming and beginnings of the maize introduction
  - **surfing the maize wave** when farmers are deeply involved in changing cropping practices to increase labour productivity and do not observe negative effects of their practices, e.g. soil erosion or yield decreases,
  - **maize aftermath**, the ultimate stage in the processes of intensification, specialisation of agriculture, associated with increasing risks of land degradation and health hazards related to use of chemicals (e.g. Phakhae Tai, Nammen).
- The **maize boom cannot be stopped** once it has started. These are lessons from other districts in Xieng Khouang (e.g. Kham) other provinces in Laos (e.g. Sayabouri, Oudomxay)

[2] Suicides by ingestion of herbicides have been reported but are not considered here as contributing to the process of environmental degradation as the reasons for suicides are completely independent from the status of the environment.

and other countries (e.g. Thailand, Vietnam). Thus, the most practical option should be partnering with villagers to:

- Prepare for the aftermath of the boom with **solutions adapted to their local situations**,
- **Preserve the complex landscape mosaics** wherever it is still possible,
- **Share experiences**: villages that are at the initial stage of the maize boom may learn lessons from places where maize expansion has led to environmental issues through activities such as cross-site visits or awareness campaigns organized by villagers themselves.

Short-term solutions

Proposed short-term options do not involve major transformation of the maize system but may help delay the inevitable yield decline due to mono-cropping and provide better economic conditions in the face of price fluctuations.

First, as observed in other contexts, draining nutrients (i.e. Nitrogen, Phosphorus, Potassium) from the soil, harvest after harvest, without any restitution through proper **residue management** and/or **fertilisation** inevitably leads to yield decline. Solutions exist and have been successfully tested in other contexts, such as no tillage, no residue burning practices (conservation agriculture), or use of chemical or organic (manure) fertilisers.

When proposed to Phakhae Tai farmers during the focus group discussion the response was very strong: "*we already know these techniques, some of us already tested them,*" but, "if *there is no tillage and no burning, then it means nothing to eat*" (ຖ້າ ບໍ່ ໄຖ, ບໍ່ ຈູດ ກໍ່ຈະບໍ່ ມີ ຫຍັງ ກິນ). In fact, villagers are reluctant to use alternatives to existing intensive practices as long as they are economically viable, as the proposed alternatives require more investments in terms of agricultural input and labour. However, there is a turning point where alternative systems will attract the interest of maize producers, and agricultural extension agents should be ready to help once this point is reached.

Second, the **promotion of safe use of herbicides** would be an improvement compared to current practices in most villages. Many projects are already involved in such activities in other regions of Laos and also in Nonghet. Posters and training materials are readily available from these projects and DAFO staff can be easily mobilised. However, there is a risk that the promotion of the safe use of herbicides can be misinterpreted by villagers as the promotion of herbicide use, which has happened in some projects in the past. As in other countries and provinces of Laos, DAFO staff may play an ambiguous role of promoting safe use of pesticides with development partners on one hand, and on the other hand engaging with agrochemical companies in promoting the use of pesticides. Careful analysis of the intervention strategies are therefore necessary and should include clear adaptation mechanisms to local contexts (e.g. biophysical conditions, access to market, stages in the maize boom), to avoid creating more problems than solutions.

Third, in the face of aggressive trading and middlemen strategies to impose production packages (i.e. including tillage and chemical pesticides), and also fluctuating input and maize prices, farmers would reap a larger portion of the maize benefits if they were better organized. **Farmers' groups** would help with negotiating lower prices for the inputs, training members on safer practices, and gathering products so that they can be sold at a higher price. Small farmers tend to sell maize right after their harvest as they need money rapidly, selling at the lowest market price. Farmers' groups or small producer cooperatives with storage facilities would help increase the product quality (i.e. better drying conditions and less post-harvest damages by pests) and, with transportation facilities, would be able to **bargain higher prices** with buyers in Vietnam. Storage facilities would

allow them to wait for the time after the harvest when prices are higher and larger volumes would allow economies of scale.

Again, this option was rejected during focus group discussions and did not trigger any reaction during the restitution workshop because villagers systematically privilege individual options. They would get together only if such an option provided visible, measurable, benefits. Otherwise, they prefer to minimise transaction costs by working alone or with the close circle of relatives they can trust. Indeed, the trust building process takes time and long-term investment would be required to implement this option. In the short-term, the village head from Phakhae Tai requested a tax reduction on land and labour, complaining that these taxes (20.000 kip/ha maize and 15.000 kip/person involved in shifting cultivation) are too high and lower the benefits to producers. He complained that businessmen and tax collectors get most of the maize benefits and that not enough is retained by producers. As the return on land is estimated at more than 8 million kip per hectare of maize, one may wonder how much the maize price would increase if the tax were reduced. On the other hand, as taxes are used to support DAFO extension activities, lower taxes would mean even less support to agricultural development in the district.

Long-term solutions

Long-term solutions involve profound transformations of the current agricultural systems. Two complementary options have been proposed to engage village communities in an alternative development pathway.

The first involves creating an enabling institutional environment for the promotion of alternative, more diversified farming systems. Three main activities could be promoted:

- Advocacy work against use of chemical pesticides grounded in empirical data about the risks for humans and the environment. This activity would include monitoring and reporting about chemical residues in soil, water, and food, intoxication cases, etc.
- Support to district and provincial authorities in drafting and enforcing regulations against the use of chemicals, as is now the case in Huaphan Province.
- Promotion of alternative maize cropping systems based on rotation and/or association with legume crops (i.e. naturally nitrogen-fixing plants) that do not require the use of chemical herbicides (e.g. maize-vigna, maize cajanus). Control of weeds through combinations of crop in time and space, requiring coordination among farmers who cultivate the same watersheds.

The second entails promoting more integrated farming systems, based on a combination of crops, livestock and forest products. While traditional systems were already organic (no use of chemical inputs) and integrated (combination of crops, livestock and forest), the idea here is not to return to former subsistence-based cropping systems but to deliberately promote new forms of commercially-oriented agroecological systems. Shifting cultivation systems have been banned by the government because of their perceived destructive effects on forests, although maize mono-cropping, which has been promoted by the government as a commercial alternative to so-called “backward” practices, has done even worse damage in terms of environmental degradation. The point here would not be to return to the former nor to build on the latter, but to promote integrated farming systems as modern agroecological alternatives for future agriculture in Nonghet District, and more broadly in the northern uplands of Lao PDR. Three main activities could be promoted towards this strategic objective:

- Crop-livestock-tree integration. A non-exhaustive list of possible combinations discussed during the short missions is proposed:
  - Maize – pig system. Feeding pigs with maize has been a traditional system for decades before the introduction of hybrid maize. It is still found in many villages in northern Laos and in neighbouring Vietnam. When asked if they would be willing to feed the pigs with

hybrid maize if the price decreased farmers responded that (i) they prefer getting money rapidly after selling maize, instead of waiting several years for pig fattening, and (ii) pigs do not eat the grains from hybrid maize because they are too hard. However, economic calculations have shown that farmers would make a larger profit from pig fattening, though this would require some initial investments in pig stalls and equipment to prepare pig feed from maize, cassava and legume crops that would be produced on-farm. The additional labour input could be compensated by the use of pig manure for soil fertilisation, which would bring about a virtuous circle of soil regeneration (combined use of legume crops and manure) and help recover from the vicious cycle of maize mono-cropping.

- Paddy + winter crops (vegetables, medicinal herbs) would be combined in the lowlands while perennial trees would be grown on the slopes: tropical (mangoes, lychees) or temperate (plums, peaches, cherries, chestnuts, persimmons, apples, etc.) fruit trees, depending on the biophysical environments, or industrial trees (tea, coffee, etc.). Before the tree plantations are productive a combination of annual crops (e.g. maize + legumes) could be cropped within the tree inter-rows. Then, once the plantations are well-established, a legume crop such as Arachis pintoi could cover the soil and be pastured by large livestock.
- Livestock management systems should be changed from extensive scavenging livestock to commercial production (vaccination, improved feeding system, etc.). This has been the main objective of many development projects in Xieng Khouang Province, both in the past and today. There are a lot of experiences reported in the literature and it is therefore not necessary to go into great detail here about what could be done. An excellent presentation of livestock development pathways is proposed in Connell (2005).

- Maintaining or recreating complex landscape mosaics through diversification and integration of agricultural activities. Landscape management approaches based on collectively-designed land use plans is a very promising option for future livelihood development that balances biodiversity management, water and soil preservation, and agricultural production. Instead of a single crop or livestock approach (e.g. bringing chickens to villagers who already have plenty) a well-planned combination of well-integrated activities will have a long standing impact beyond the project duration (Castella et al., 2012).
- Identifying, studying, and disseminating existing alternative models that are already in place in Nonghet District, and have been successfully tested by innovative villagers, e.g. improved pasture systems in Pha-En, commercial pig farming in Phakhae Tai (Figure 23). Building on the experience of local champions would facilitate farmer-to-farmer experience sharing and extension activities.

Figure 23. Existing alternative practices found in Nonghet District (e.g. improved pasture, home gardens, commercial pig farm).

During the restitution workshop, participants were divided into two groups to discuss the practical implementation of these scenarios in their villages. As two representatives of each village joined the meeting, one of them was present in each group and the discussions were supported by three representatives of DAFO, one representative of DoNRE, three ChildFund staff, and representatives from two other projects active in Nonghet (i.e. UDIN project, Helvetas).

The main results of both group discussions are related to short-term and long-term solutions to the issues discussed during the workshop:

Group 1
Short-term solutions after the maize boom would be:

1. intercropping maize and fruit trees initially and stopping maize cultivation when the orchard becomes productive,
2. land-use planning and creating land management regulations,
3. creating livestock farmer groups and dividing responsibilities among group members. They would first start with small livestock such as goats, and expand group activities if successful,
4. developing weaving and sewing groups to engage women in income generating activities.

In the long term, improved crop cultivars and livestock species (both small and large livestock) should be introduced and tested in farming conditions. Farmer groups will diversify their activities and expand, for example to pig, poultry and large ruminants. Relevant training and extension activities should be proposed by DAFO with the support of projects.

Group 2
Develop livestock production individually – not as farmer groups – because land is too limited and this create would tensions between households:

1. grow grass in suitable areas; villages that lack water should install water tanks in the pastures for the animals,
2. systematically vaccinate all livestock to prevent diseases,
3. grow supplementary animal feed (e.g. maize, cassava, beans).

Technical training and seed provision provided by DAFO and ChildFund on:

1. fruit trees,
2. pig production
3. secondary crops, e.g. peanut, ginger, soybean, that can be sold for a good price and can gradually be oriented towards commercial production, if successful. Domestication of ມາມ ຂ່າ (wild galangal young flower), a NTFP that can be sold at a good price (9.000 kip/kg), but that disappeared from the landscapes at the same time as the forests.

Project support to women's groups, especially for weaving and sewing activities.

The head of the DAFO delegation summarised the main lessons from the meeting as follows:

- the project should adapt the proposed techniques to the local situation of all villages,
- activities should be planned together with the intended beneficiaries: the low-income villagers,

- more villagers should be organised as producer groups to facilitate the task of extension agents DAFO will provide support and training on the techniques that will be adapted to sustainable agricultural production.

Mr. Khamphanh, ChildFund project officer on agriculture and natural resource management finally concluded with the following points:

- village development plans should systematically be made compatible with the ones of the district authorities,
- food security must be ensured before thinking about commercial production, as many families in the district are still food insecure,
- agricultural production should be adapted to the market demand through value chain analysis prior to introduction of a new production to avoid the risk of market saturation that would bring the prices down.

Figure 24. Participatory scenario exploration: focus group discussion in Dindam and restitution meeting in Nonghet.

V. Conclusions: Recommendations for Sustainable Intensification of Agriculture

In conclusion, practical lessons can be drawn from the short diagnostic study conducted in Nonghet District. A number of recommendations are proposed to orient ChildFund project activities towards more secure livelihoods and sustainable intensification of agriculture. Our intention here is not to provide recommendations specific to the villages that were visited during the study. While this is partially done in the previous sections of this report, intervention planning would require a more thorough diagnosis specific to each village before co-designing interventions with villagers. Instead, we believe that our rapid assessment, based on only two weeks of direct investigations in Nonghet District, can support the definition of intervention principles and provide recommendations for fruitful engagement with local communities in addressing their most urgent and important issues related to agriculture and livelihoods.

Diverse local situations require a diversity of development options and intervention mechanisms

The diversity of village and household situations found in Nonghet District should be considered positively as an asset to the development of the overall district. Diversity means richness of opportunities and resilience in the face of unpredictable events, e.g. climatic events, or fluctuation in commodity prices. However, diversity also means that a one size fits all approach will not work. The many constraints faced by villages and also their development opportunities need to be well understood to guide relevant interventions. This study tackled this apparent complexity by identifying two main keys for village classification: agroecology and accessibility.

- **Agroecology**

Agricultural **potentialities** are highly dependent on the local agroecology: a combination of biophysical factors such as soil quality, slope, rainfall, solar radiation, and temperatures that define crop suitability and relevant cropping practices to optimise agricultural potentialities. Nonghet District is characterized by cool zones where, for example, temperate fruit trees can be grown and warm zones - preferred by maize growers - where tropical fruit trees can grow easily. Plant physiology is largely determined by temperature sums and solar radiation. Day length is also important for the development of photoperiodic cultivar. As a consequence, the agroecological contexts allow plants to express their potentialities or can heavily constrain them, as last year in Dindam, where grain filling did not happen on upland rice crops, leading to many empty grains and a poor rice harvest. Cases were also reported of specific combinations of temperature and solar radiation leading to healthy, leafy soybean plants that proceeded not to flower, resulting in no harvest.

- **Accessibility**

Agricultural **opportunities** are highly dependent on accessibility to information, innovation, market, etc. Development processes are often delayed in villages located far from the main roads. As a consequence, a time lag in land use changes can be associated with the distance or the accessibility - sometime the distance is not a problem but access is constrained by a bad quality road or a missing bridge. It is therefore possible to predict what may happen in a distant location by observing on-going trends in the most accessible villages. Lessons drawn from the observation of villages that are different in terms of accessibility can help more remote villages in avoiding problems faced by more accessible villages. Recommendations were made in the previous section to organise village cross visits to increase villagers' awareness about issues related to local development.

The three stages in the maize boom presented in the previous section are highly dependent on the local agroecology and accessibility. As intervention topics and mechanisms have to be adapted to these three stages, it is important to identify the position of partner villages of the project along this sequence.

1. in remote areas, still practicing shifting cultivation without chemical inputs, the main objective would be to avoid falling into the herbicide treadmill by promoting agroecological principles and practices such as organic integrated farming, and conservation agriculture. Extension materials are available from CLICK (http://clicklaos.org/), as well as other agricultural development initiatives in Laos.

2. in villages in the middle of the maize boom, already "addicted" to herbicides, not much can be done as no convincing alternative to maize is available (e.g. with the same return on land and labour) as long as the negative side effects (i.e. soil erosion and contamination by herbicides) are not perceived. Interventions may concentrate on training on the safe use of herbicides, land demarcation to avoid maize expansion beyond areas delineated in the land use plans, and preparation of future alternative cropping and livestock systems.

3. in villages entering the maize aftermath stage, the priority is to revive alternative production systems, and to restore the landscape ecology and biodiversity by recreating complex landscape mosaics. Local communities have to engage in a stepwise process of recovery from a maize-herbicide "addiction." Agricultural production should be gradually diversified through development of livestock grazing areas, improved pastures, crop associations, and perennial trees.

Villages are complex socio-ecological systems that require integrated approaches to development

Focus group discussions about villagers' perceptions of development project interventions show that villagers adjust their demands to whatever activity the project can bring them, instead of considering their own priorities. One reason for this may be the difficulty of formulating their priorities in a holistic manner as all aspects of their livelihoods are interrelated. The simple description of the symptoms of their problems often lead the district staff to consider the symptoms as the problems, ending up with a shopping list of disconnected extension activities instead of an integrated problem-solving approach. On the other hand, when the problems are presented in their overall complexity they become overwhelming. Villagers don't know how to grasp them, or how to start. Untrained DAFO staff often have a hard time trying to help.

As a result, district administrations and supporting projects often end up treating the symptoms of the problems because they are easier to handle by implementing more highly visible activities, as it is important to show results rapidly. Through this process, an integrated poverty alleviation, food security and livelihood improvement project can be transformed for villagers into a chicken project, a pig project or a water adduction project. This trend was clearly perceptible during the group discussions that took place during the restitution workshop. Village heads initially thought in term of punctuated disconnected extension activities instead of considering integrated village changes. They considered for example, that problems of yield decrease should be fixed by introduction of new varieties, that producer groups would make goat raising more profitable, without having to change their production practices, reform local institutions (e.g. sanction mechanisms on deviant behaviour) and landscape management rules, which are the more complex, coordinated changes required to achieve real, lasting impact. The latter are more complex, less visible and more time-consuming activities that require good coordination among villagers and with support agencies. While everyone would agree that addressing the root causes of the problems would provide stronger impacts and more lasting outcomes, projects are often

reluctant to engage in the required integrated approach because they lack the capacity, the time or the mandate to do so.

Clearly, Nonghet villagers do not need more chicken projects. They do not need a project that offers them cows, when the Nayobay Bank proposes loans at 7% interest rate per year on livestock as part of a government campaign to eradicate poverty. Grants on large livestock would not support the government campaign of providing credit with low interest rates and may also reduce villagers' accountability. Of course villagers are happy to take whatever the project would bring them for free, but it may not address the roots of the villagers' problems nor contribute to the livelihood improvement objectives of the project.

Guidance provided during the group discussions finally led participants in the restitution workshop to formalise a stepwise intervention process. These first elements are very promising. They show that villagers can be involved in land use planning, to collectively define development goals and then engage in a theory of change process[3] to define the successive stages of an intentional, coordinated transformation process. In the context of 'maize aftermath' villages for example, this would consist of first changing livestock management systems to allow a diversification of upland cropping systems (e.g. crop association and rotations) and then a gradual restoration of the degraded agro-ecosystems (see practical options suggested in the 'scenario exploration' section here above).

Support to such an integrated approach to local agricultural development may be organised as follows:

1. **Mapping intervention area**, i.e. Nonghet District, based on the proposed indicators, to classify villages according to their potentialities, opportunities and stage in a regional development trajectory. A village typology will help identify villages that face similar problems and require similar intervention pathways;
2. **Empowerment of both village communities and district organisations** in **co-designing intervention strategies** specific to each village type. Real ownership of the planning process is essential for successful implementation and lasting impacts after the project ends. Project fatigue observed in some villages can be avoided if village communities clearly see the benefit of investing their precious time with the project, if they feel accountable for the transformation process in which they are engaged;
3. Provision of **training and support to both village communities and DAFO staff** to **monitor impacts** of their activities (i) to readjust intervention mechanisms so as to adapt to a changing environment, (ii) to demonstrate the potentialities of alternative production practices through farmer field schools or support to district-led technical service centres, (ii) to capitalise on knowledge gained from experience so that it can be shared and disseminated beyond the partner villages of the project.

[3] www.theoryofchange.org, http://en.wikipedia.org/wiki/Theory_of_change

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Appendix 1: *Household survey questionnaires*

Household survey questionnaires

ແບບສອບຖາມຄອບຄົວ

ຊື່ບ້ານ :	ດຳລັບບ້ານ:	ວັນທີ :
ຊື່ຜູ້ເກັບຂໍ້ມູນ :		ລຳດັບແບບສອບຖາມ :
ຊື່ຄອບຄົວທີ່ສຳພາດ :		
ຊື່ຫຼິ້ນຫຼືຊື່ເອີ້ນໃນບ້ານ :	ໜ່ວຍ :	ຊຸມເຜົ່າ :

1. ໂຄງສ້າງຂອງຄອບຄົວໃນປີ 2013

	ຊື່ຫົວໜ້າ ຄອບຄົວ	ອາຍຸ	ເພດ	ລະດັບການສຶກສາ(1)	ຖານະໃນສັງຄົມ ໜ້າທີ່ຮັບຜິດຊອບໃນບ້ານ(2)	% ຂອງເວລາ ໃນການທຳການຜະລິດ
1						

(1) : **A** : ຄົນບໍ່ຮູ້ໜັງສື . (2) :ຄູ,ຊາວໜຸ່ມ, ແມ່ຍິງ, ແມວໂຮມ, ນາຍບ້ານ,
ປະຖົມ : **P1, P2,..., P5**ຄະນະບ້ານ, ປ້ອງກັນ, ກອງທຸລອນ,ເລຂາພັກ
ມັດທະຍົມຕົ້ນ : **M1, M2,M3** ປ່າໄມ້ບ້ານ, ພາສີບ້ານ, ຫົວໜ້າໜ່ວຍ...
ມັດທະຍົມປາຍ : **M4, M5, M6**(ເອົາແຕ່ຫົວໜ້າແລະຮອງ)
ຈົບວິຊາສະເພາະ **: U**

ສະພາບຄອບຄົວ	**ຈນ ລວມ**	**ຈນ ຊາຍ**	**ຈນ ຍິງ**
ສະມາຊິກໃນ ຄຄ			
ຈຳແຮງງານຕົ້ນຕໍ			
ຈນ ຜູ້ເຖົ້າ			
ຈນ ຜູ້ໃຫຍ່			
ຈນ ເດັກນ້ອຍ			
ຈນ ເດັກບໍ່ໄດ້ເຂົ້າໂຮງຮຽນ			

(*ເດັກນ້ອຍ ແມ່ນຕ່ຳກວ່າ ≤ 12ປີ)

2. ເຈົ້າໄດ້ເຂົ້າຮ່ວມໂຄງການໃດແດ່ ໃນ 5 ປີຜ່ານມາ ? (ຊື່ໂຄງການ ? ຈາກປີໃດຫາປີໃດ? ກິດຈະກຳທີ່ເຂົ້າຮ່ວມ)

1).....

2) .....

3) .....

4) .....

3. ການປ່ຽນແປງການປູກພືດ**ຕັ້ງແຕ່ປີ 2009**ເປັນຕົ້ນມາ **(ເອົາແຕ່ລະເພາະພືດທີ່ປູກເປັນຕົ້ນຕໍຫຼືປູກຫຼາຍ)**

ສາລີ (ພັນປະສົມ)□ສາລີ (ພັນພື້ນເມືອງ) □ ໝາກເຜັດ□ ກະທຽມ□ຖົ່ວເຍີ□ ຜັກບົ່ວ□ມັນຕົ້ນ□ ໝາກເດືອຍ□ ໝາກທຽ□ຖົ່ວດິນ□ຖົ່ວຍາວ□ ນາປີ□ ເຂົ້ານາແຊງ□ ເຂົ້າໄຮ່□ໝາກນ້ອຍ□ໝາກຮຸ່ງ□ໝາກໄມ້□ ກາລໍາປີ□ຜັກກາດ□ໝາກໜັດ□ອື່ນໆ									
ຊະນິດພືດ	**ເນື້ອທີ່ ປີ 2013 (ຮຕ)**	**ຜົນຜະລິດໃນປີ 2013 (ກິໂລ)**	**ປະລິມານຂາຍ ໃນປີ 2013 (ກິໂລ)**	**ລາຄາ 2013 (ກີບ/ກິໂລ)**	**ປະລິມານແນວ ປູກໃນປີ2013 (ກິໂລ)**	**ເນື້ອທີ່ປູກ ໃນປີ 2012 (ຮຕ)**	**ເນື້ອທີ່ປູກ ໃນປີ 2011 (ຮຕ)**	**ເນື້ອທີ່ປູກ ໃນປີ 2010 (ຮຕ)**	**ເນື້ອທີ່ປູກ ໃນປີ 2009 (ຮຕ)**

- ຊື້ເຂົ້າກິນບໍ ໃນປີ 2013? ຊື້ຈັກ (kg).....
- ເອົາເງິນມາຈາກໃສ ?.....

1. ອຸປະກອນການນໍາໃຊ້**2013**

ພາຫະນະຮັບໃຊ້	**ຈໍານວນເທົ່າໃດ**	**ຊື້ປີໃດ**	**ລາຄາ (ເປັນກີບ)**
ລົດໄຖນາໃຫຍ່			
ລົດໄຖນານ້ອຍຫຼືລົດໄຖນາ ເດີນຕາມ			
ໂຮງສີເຂົ້າ			
ໂຮງສີສາລີ			
ລົດຈັກ			
ລົດໃຫ່ຍ (ເກງ, ກະບະ...)			
ລົດບັນທຸກໃຫຍ່			
ຮຸນໄດຫຼືລົດບັນທຸກນ້ອຍ			
ກີ່ຕໍ່າທຸກຫຼື ຟີມຕໍ່າທຸກ			

ອຸປະກອນໄຟຟ້າ	**ຈໍານວນເທົ່າໃດ**	**ຊື້ປີໃດ**	**ລາຄາ (ເປັນກີບ)**
ໂທລະທັດ			
ຕູ້ເຢັນ			
ໂທລະສັບ (ມືຖື +ຕັ້ງໂຕະ)			

ເຮືອນ		**(ຕື່ມ✔ໃສ່ ໜ້ອງລຸ່ມນີ້)**	**ກໍ່ສ້າງເຮືອນໃໝ່ຕື່ມບໍ ? ປະເພດໃດ ? ສ້າງປີໃດ ?**
ພື້ນ ຫຼື ຝາ	ໄມ້ປ່ອງ		
	ໄມ້ແປ້ນ (ໄມ້ຈິງ)		
	ຊີມັງ / ດິນຈີ່		
ຫຼັງຄາ	ໄມ້ປ່ອງ/ຫຍ້າຄາ		
	ແປ້ນໄມ້ຈິງ		
	ສັງກະສີ		
	ກະເບື້ອງ/ດິນຂໍ		

2. **ການປ່ຽນແປງຮູບແບບການລ້ຽງສັດນັບຕັ້ງແຕ່ປີ 2009** ເປັນຕົ້ນມາ(ຖ້າຊາວບ້ານບໍ່ຈື່ບໍ່ເອົາລະອຽດທຸກປີກໍ່ໄດ້)

	2013		**2012**		**2011**		**2010**		**2009**	
	ລວມ	ຈຳນວນໂຕແມ່	ລວມ	ຈຳນວນໂຕແມ່	ລວມ	ຈຳນວນໂຕແມ່	ລວມ	ຈຳນວນໂຕແມ່	ລວມ	ຈຳນວນໂຕແມ່
ງົວ										
ຄວາຍ										
ມ້າ										
ໝູ										
ແບ້										
ສັດປີກ										

3. **ສະມາຊິກໃນຄອບຄົວມີລາຍຮັບເພີ່ມຈາກກິດຈະກຳພາຍນອກບໍ ?**

ການຕຳໜູກ□ ເຄື່ອງຈັກສານ□ ຄ້າຂາຍ□ການເກັບເຄື່ອປ່າຂອງດົງ□ ການຂີນສິ່ງ□ ຊ່າງຕີເຫຼັກ□ ກໍ່ສ້າງ□ຈ້າງເຮັດວຽກ□ ການໄຖນາ□ເງິນເດືອນ □ອື່ນໆ

ລດ	**ກິດຈະກຳຫັຍໆ ?**	**ຈັກເດືອນ/ຈັກມື້ຕໍ່ປີ ?**	**ນັບຕັ້ງແຕ່ ເມື່ອໃດ ? (ປີ)**	**ລາຍຮັບລວມ ປີ 2013 (ເປັນກີບຕໍ່ປີ)**

4. ລາຍຮັບຈາກແຫຼ່ງອື່ນໆ ທີ່ບໍ່ໄດ້ອອກແຮງງານ ໃນປີ **2013**ມີແຫຼ່ງໃດ ?

ລດ	ແຫຼ່ງລາຍຮັບ(ເງິນພີ່ນ້ອງຝາກໃຫ້, ມີເຮືອນໃຫ້ເຊົ່າ, ມີດິນໃຫ້ເຊົ່າ...)	ໄດ້ຮັບຈຳນວນເທົ່າໃດ ໃນປີ**2013 (ກີບ/ໂດລາ) ຫຼື ເປັນເຂົ້າ,**ເປັນ**ວັດຖຸ ?**

5. **ເຈົ້າໄດ້ໄປເກັບ**ເຄື່ອງປ່າຂອງດົງບໍ ປະເພດໃດ?

ໜໍ່ໄມ້□ ຫວາຍ□ ໝາກແໜ່ງ□ ຫົວຂ່າ□ ໝາກແຕງປ່າ□ນ້ຳມັນຍາງ□ ດອກແຂມ□ ນ້ຳເຜິ້ງ□ຕົ້ນປໍ ສາ□ຂີ້ຊີ□ ຫົວຂ່າ□ ພືດທີ່ເປັນຢາ□ ໄມ້ໄຜ່□ ເຫັດ□ໄມ້□ການລ່າສັດ□ໝາກໍ່ □ ອື່ນໆ

ຜະລິດຕະພັນຫັຍໆ ?	ໃຊ້ເພື່ອຫັຍໆ ? (ອາຫານ, ກໍ່ສ້າງຕ່າງໆ, ຢາ ປົວພະຍາດ...)	ປະລິມານທີ່ເກັບໄດ້	ປະລິມານຂາຍ	ລາຍຮັບລວມ ຕໍ່ ປີ (ກີບ)

6. **ເຈົ້າກູ້ຢືມເງິນບໍ ?**

ຈຳນວນເງິນ ຫຼືວັດຖຸທີ່ກູ້ຢືມ	ນຳໃຊ້ເຮັດຫຍັງ	ຢືມຈາກໃສ	ໄລຍະກູ້ຢືມ (ຈັກເດືອນ, ຈັກປີ)	ອັດຕາດອກເບ້ຍ

ເງິນກູ້ຢືມທົດແທນຄືນໝົດຫຼືຍັງ ? ຖ້າຍັງຈຳນວນຄ້າງເທົ່າໃດ ?.....

7. **ຄຳຖາມເພີ່ມເຕີມ ? (ໝາຍ ✓ ໃສ່)**

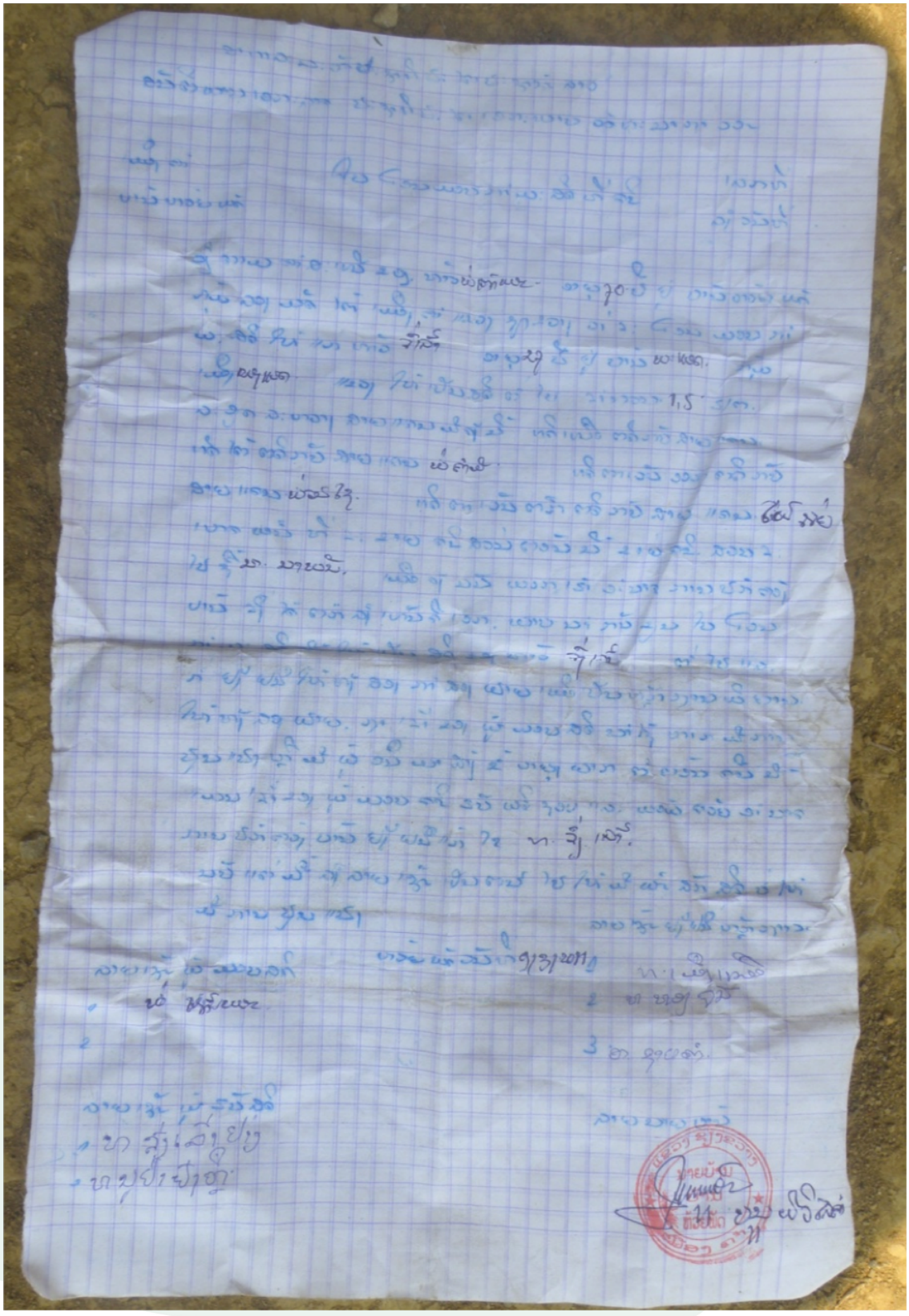
ລດ	ຄວາມຮູ້ສຶກ ໃນ 5 ປີຜ່ານມາ ຕໍ່ກັບສິ່ງເຫຼົ່ານີ້ (ນັບແຕ່ປີ 2009 ເປັນຕົ້ນມາ)	ລຸດລົງຫຼາຍ	ລຸດລົງໜ້ອຍໜຶ່ງ	ຄືເກົ່າ	ເພີ່ມຂຶ້ນໜ້ອຍໜຶ່ງ	ເພີ່ມຂຶ້ນຫຼາຍ
		-2	-1	0	1	2
1	ເຈົ້າຮູ້ສຶກແນວໃດ ກ່ຽວກັບລາຍຮັບລວມຂອງເຈົ້າ					
2	ເຈົ້າຮູ້ສຶກແນວໃດ ກ່ຽວກັບລາຍຮັບຈາກກິດຈະກຳອື່ນໆ ທີ່ບໍ່ແມ່ນການກະສິກຳ					
3	ຈຳນວນ ໜີ້ສິນ					
4	ຄວາມຕ້ອງການແຮງງານ ໃນການຜະລິດ					
5	ຜົນຜະລິດເຂົ້າໄຮ່					
6	ຜົນຜະລິດເຂົ້ານາ					

7	ຜົນຜະລິດສາລີ					
8	ຄວາມອຸດົມສົມບູນຂອງດິນ					
9	ການເຊາະເຈື່ອນຂອງດິນ ໃນຂົງເຂດທຳການຜະລິດ					
10	ການນຳໃຊ້ຢາຂ້າຫຍ້າ					
11	ການນຳໃຊ້ ປຸຍເຄມີ					
12	ບັນຫາສຸຂະພາບ (ຈາກການໃຊ້ຢາຂ້າຫຍ້າ ຫຼື ປຸຍ)					
13	ຈຳນວນ ຊະນິດພືດທີ່ປູກ					
14	ຈຳນວນ ຄັ້ງທີ່ໄປຕະຫຼາດຕໍ່ເດືອນ					
15	ຈຳນວນ ຄັ້ງທີ່ໄດ້ເຂົ້າຮ່ວມການຝຶກອົບຮົມຕ່າງໆ					
16	ຈຳນວນ ເຄື່ອງປ່າຂອງດົງ ທີ່ເກັບໄດ້					
17	ເນື້ອທີ່ປ່າໄມ້					

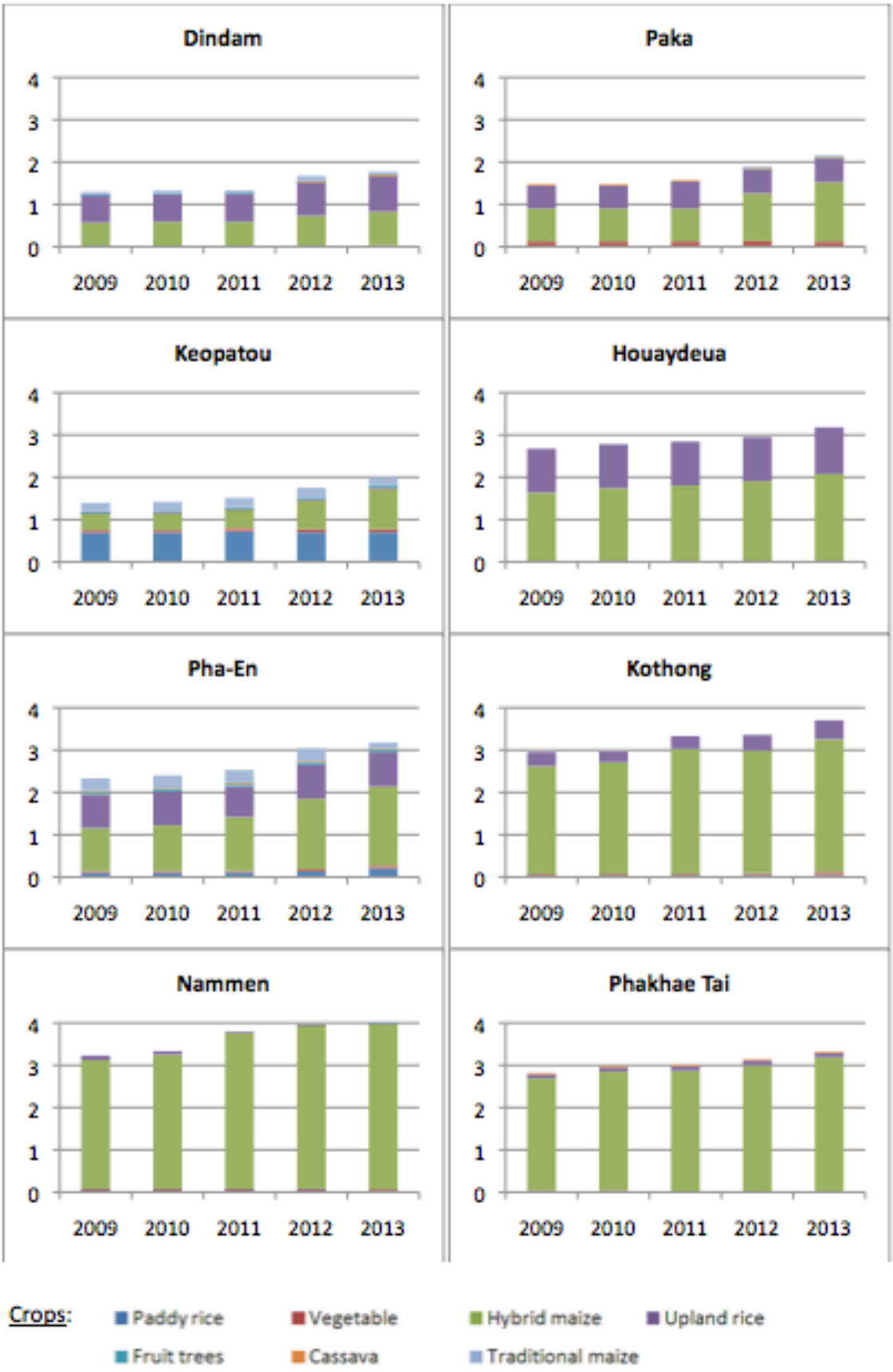
8. ການໃຊ້ຈ່າຍເງິນທີ່ຫາມາໄດ້ ? (ໝາຍ ✓ ໃສ່)

ລດ	**ຄວາມຮູ້ສຶກ ໃນ 5 ປີຜ່ານມາ ຕໍ່ກັບສິ່ງເຫຼົ່ານີ້ (ນັບແຕ່ປີ 2009 ເປັນຕົ້ນມາ)**	ບໍ່ໄດ້ຈ່າຍ	ຈ່າຍໜ້ອຍທີ່ສຸດ	ຈ່າຍໜ້ອຍ	ຈ່າຍທຳມະດາ	ຈ່າຍຫຼາຍ	ຈ່າຍຫຼາຍທີ່ສຸດ
		0	**1**	**2**	**3**	**4**	**5**
1	ໃຊ້ຈ່າຍເພື່ອການສຶກສາເດັກນ້ອຍ						
2	ຊື້ອາຫານ ທີ່ມີໂພສະນາການດີຂຶ້ນ (ຊີ້ນ...)						
3	ອຸປະກອນຮັບໃຊ້ໃນເຮືອນ (ໂທລະທັດ, ຕູ້ເຢັນ...)						
4	ພາຫະນະ (ລົດ, ເຄື່ອງຈັກຕ່າງໆ)						
5	ການລົງທຶນ ສຳລັບການທຳການຜະລິດ						

Appendix 2: *Picture of land sale certificate for maize cultivation in Pha-En Village*



Appendix 3: *Average cropping area per household (ha) in surveyed villages in 2013*

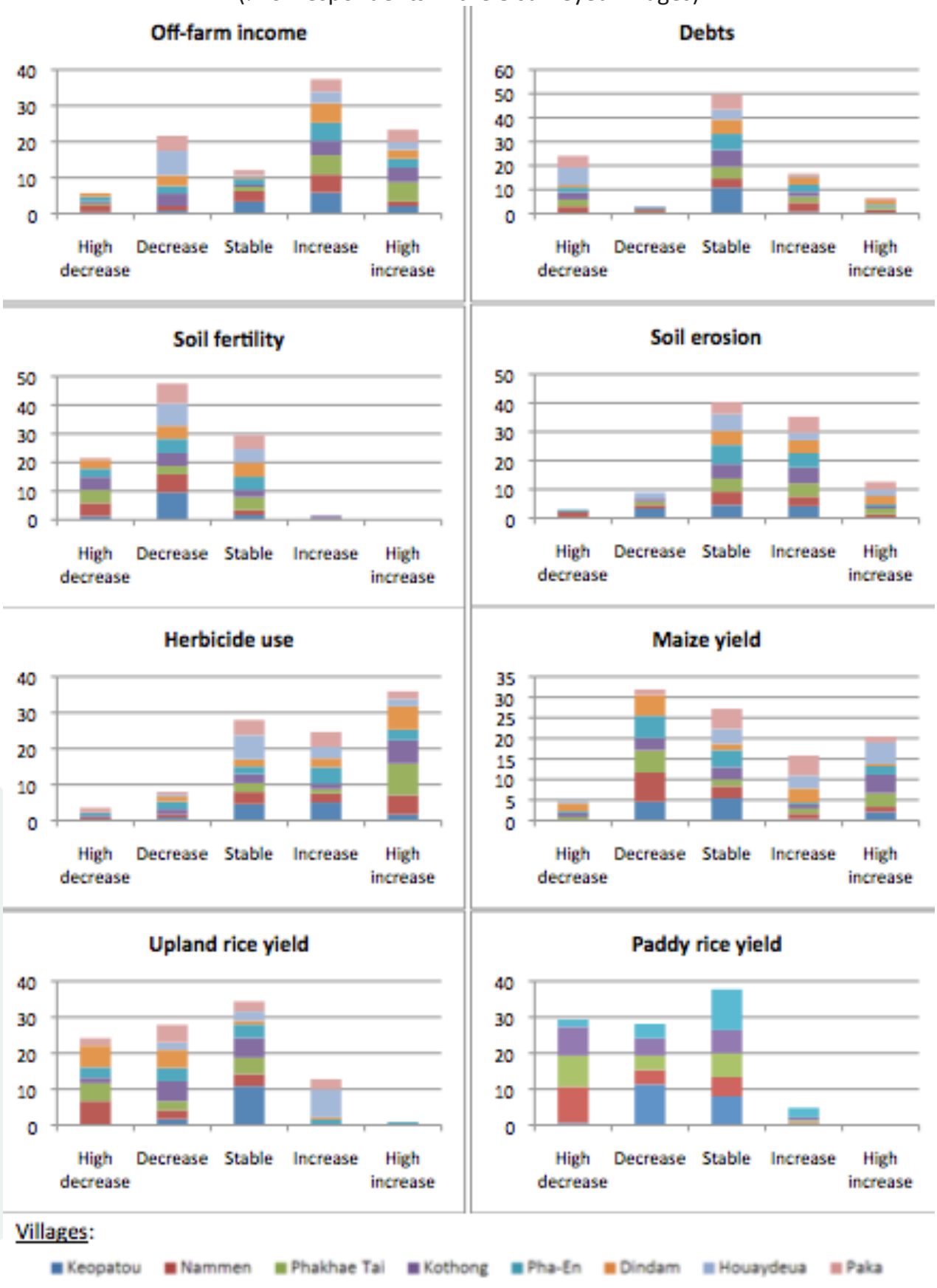


Appendix 4: *Economics of the main cropping systems in Nonghet District*

Crop	Location	Cropping Systems	Date	Code	Return to land (x1000 kip)	Return to labour (x 1000 kip)	Yield (t/ha)	Product price (x 1000 kip2013)	Labour (man.day)	Family labour (day)	Hired labour (day)	Return to family labour (x1000 kip)
Maize	Nonghet	MA_S&B	2003	N_MS3	4338	32			135			32
	Nonghet	MA_S&B	2009	N_MS9	8813	55	5,0	2,0	158			55
	Pha-En	MA_s&b_herb hand	2013	P_MSH13	8933	41	6,0	1,5	126	126	1	41
	Keopatou	MA_s&b_man	2013	K_MSM13	8489	67	5,3	1,6	112	112	0	67
	Dindam	MA_s&b	2013	D_MSM13	4400	28	4,0	1,1	118	118		28
	Pha-en	MA_till_herb motor	2013	P_MTH13	8933	53	6,0	1,5	106	106	1	53
	Keopatou	MA_till_herb motor	2013	K_MTH13	8489	69	5,3	1,6	78	63	16	87
	Phakhae Tai	MA_family labour	2013	T_MTH13	8217	49	5,1	1,6	108	107	1	49
	Phakhae Tai	MA_hired	2013	T_MTH13	8217	12	5,1	1,6	96	26	70	46
	Nonghet	MA_Till	2009	N_MT9	9988	12	5,9	2,0	80			
Paddy	Pha-en	PA	2013	P_PA13	9450	76	3,2	3,0	124	124	0	76
	Keopatou	PA	2013	K_PA13	9563	105	3,2	3,0	87	87	0	105
	Nonghet	PA	2009	N_PA9	9766	56	3,4	3,1	174			
UplandRice	Nonghet	UR_S&B + herbicide	2009	N_UH9	5265	23	1,6	3,1	238			
	Nonghet	UR_S&B	2003	N_US3	3599	13	1,5	2,5	270			
	Nonghet	UR_S&B	2009	N_US9	5617	21	1,9	3,1	267			
	Pha-En	UR_s&b_herb	2013	P_USH13	5460	41	1,8	3,0	130	130	0	41
	Pha-En	UR_s&b_man	2013	P_USM13	5460	25	1,8	3,0	220	220	0	25
	Keopatou	UR_s&b_man	2013	K_USM13	5880	47	1,7	3,5	124	124	0	47
	Dindam	UR_s&b	2013	D_USM13	5799	15	1,7	3,5	375	375	0	25
	Nonghet	UR_Till	2009	N_UT9	4097	12	1,4	3,1	340			

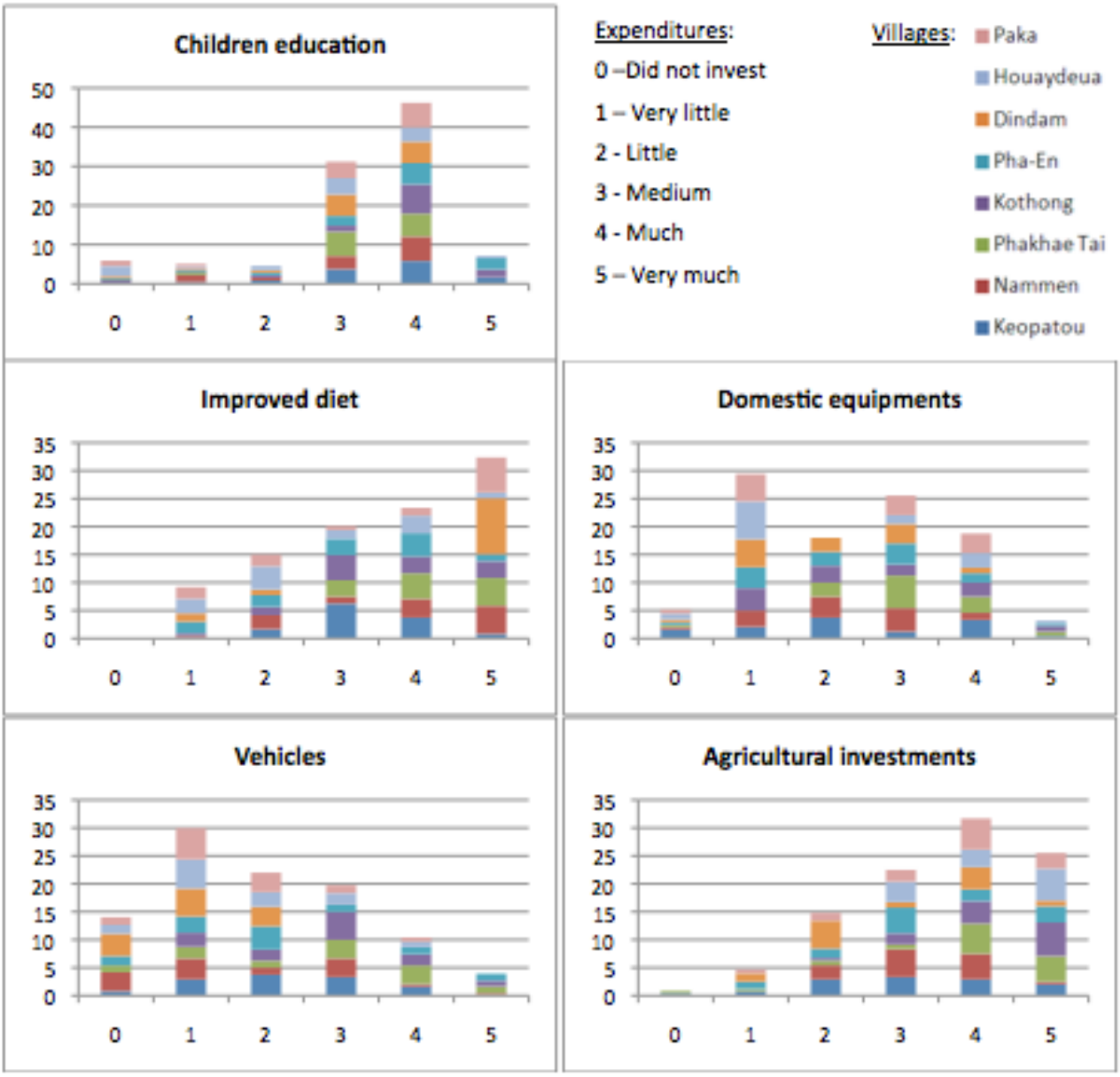
Appendix 5: *Perceived changes in livelihoods over the last 5 years*

(% of respondents in the 8 surveyed villages)



Appendix 6: *Perceived changes in household expenditures over the last 5 years*

(% of respondents in the 8 surveyed villages)



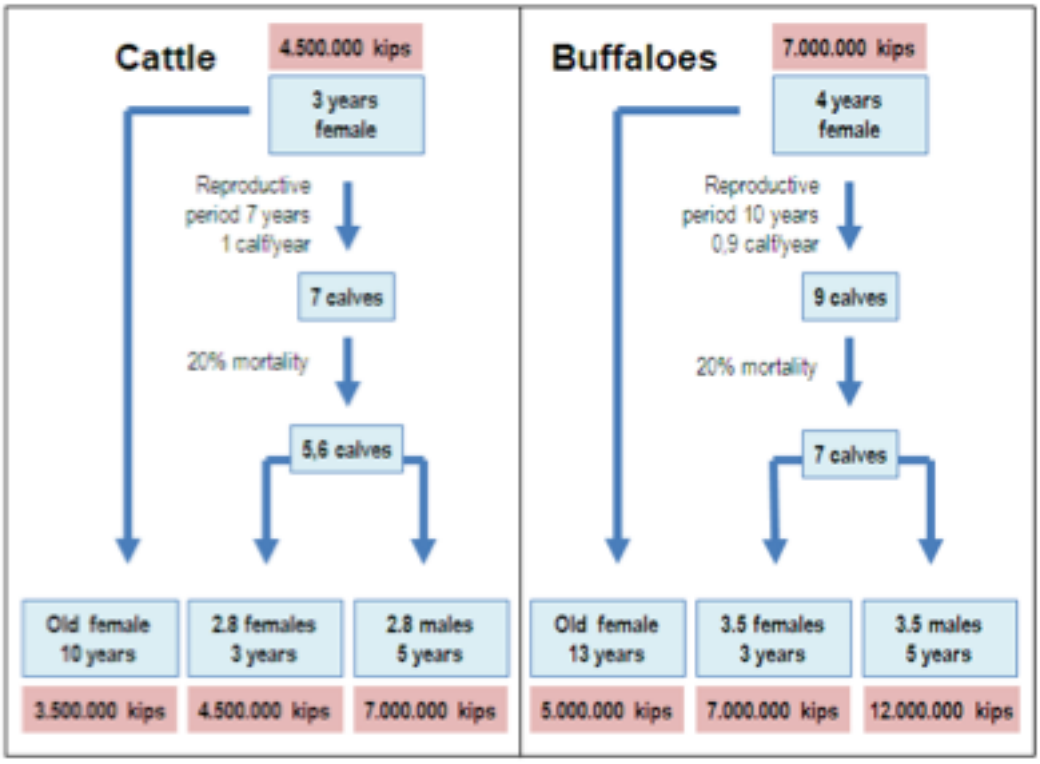
(Source: Household surveys)

Appendix 7: *Economics of livestock in partner villages*

- Gross product = Σ (animal products x average price)
- Net product = gross product – input costs
- Gross income = net product – investments (e.g. cowsheds)
- Net income = gross income - taxes
- Average annual income = net income / production period

Based on focus group discussions average values were estimated for the livestock parameters across villages. As inputs are very limited (many vaccinations and feed supplements for young animals) the main input cost is the estimated price of the reproductive female before it is sold at the end of its reproductive period (see flowcharts below describing economic calculations for each reproductive female. The household income from livestock was estimated by multiplying the number of female of each species with the annual income value calculated in the table below.

Livestock	Productive period (years)	Price old female (kip)	Number of young animals	Price mature female (kip)	Price mature male (kip)	Annual income (kip)
Cattle	7	3.500.000	5,6	4.500.000	7.000.000	4.100.000
Buffaloes	10	5.000.000	7	7.000.000	12.000.000	6.150.000
Goats	6	1.500.000	13	1.000.000	1.600.000	2.566.667
Pigs	4	1.000.000	30	1.000.000	1.500.000	4.562.500



Appendix 8: *Income distribution in the 6 partner villages*